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SHOT PRISCILLA: A TEST OF THE PLUMBBOB SERIES, 24 JUNE 1957.(U)

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A Test of the
PLUMBBOB Series
24 JUNE 1957



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United States Atmospheric Nuclear Weapons Tests
Nuclear Test Personnel Review

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report describes the activities of DOD personnel, both military and civilian, in Shot PRISCILLA, the 5th nuclear test in the PLUMBBOB atmospheric weapons testing series. The test was conducted on 24 June 1957 and involved participants from Exercise Desert Rock VII and VIII, and AEC test groups. This volume also describes the radiological safety criteria and procedures in effect at Shot PRISCILLA.		

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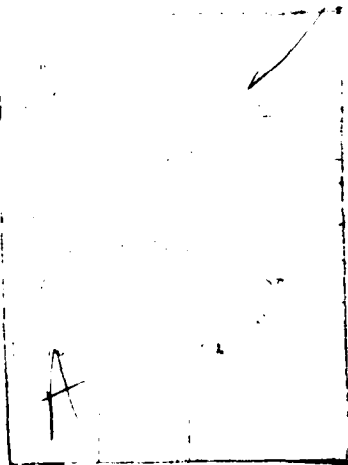
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PREFACE

Between 1945 and 1962, the United States Atomic Energy Commission (AEC) conducted 235 atmospheric nuclear weapons tests at sites in the southwestern U.S. and in the Pacific and Atlantic Oceans. In all, an estimated 220,000 Department of Defense (DOD) participants, both military and civilian, were present at the tests. Approximately 90,000 of these participants were present at the nuclear weapons tests conducted at the Nevada Test Site (NTS) north of Las Vegas, Nevada.

In 1977, 15 years after the last above-ground nuclear weapons test, the Center for Disease Control, U.S. Department of Health, Education, and Welfare (now the Centers for Disease Control, U.S. Department of Health and Human Services), noted a possible leukemia cluster among a small group of soldiers present at Shot SMOKY, the 15th test of Operation PLUMBBOB, the series of nuclear weapons tests conducted in 1957. Following that initial report by the Center for Disease Control, the Veterans Administration received a number of claims for medical benefits from former military personnel who believe their health may have been affected by their participation in the nuclear weapons tests.

In late 1977, DOD began a study to provide data to both the Center for Disease Control and the Veterans Administration on potential exposures to ionizing radiation among its military and civilian participants in the atmospheric nuclear weapons tests 15 to 30 years earlier. The DOD organized the Nuclear Test Personnel Review to:

- Identify DOD personnel who had taken part in the atmospheric nuclear weapons tests
- Determine the extent of the participants' exposure to ionizing radiation

- To provide public disclosure of information concerning participation by DOD personnel in the atmospheric nuclear weapons tests.

This report on Shot PRISCILLA is based on the military and technical documents associated with each of the nuclear weapons tests. These reports provide a public record of the activities and associated potential for radiation exposure of DOD personnel, for use in ongoing public health research and policy analysis.

Many of the documents pertaining specifically to DOD involvement during Shot PRISCILLA were found in the Defense Nuclear Agency Technical Library, the National Federal Archives Record Center, the Department of Energy Nevada Operations Office, and the Los Alamos Scientific Laboratory (LASL). The most significant documents used in the development of this report include:

- Operations Order Number 5 for Exercise Desert Rock VII and VIII
- Armed Forces Special Weapons Project (AFSWP) Final Operational Summary Report
- Final Report of Operations for Exercise Desert Rock VII and VIII
- Air Mission Summary Report of Shot PRISCILLA
- Test Director's Operation Plan 1-57
- PLUMBBOB Onsite Radiological Safety Report, prepared for the Nevada Test Organization by REECO
- Weapons Test Reports for the Armed Forces Special Weapons Project
- Air Force Special Weapons Center (AFSWC) Final Report of the 4950th Test Group (Nuclear) at PLUMBBOB
- Report of the Test Manager, Operation PLUMBBOB
- Report of the Test Director, Operation PLUMBBOB

- After Action Reports for the PLUMBBOB Series
- Internal Memoranda
- Unit Histories for the AFSWC, PLUMBBOB.

Frequently, the surviving historical documentation of activities conducted at Shot PRISCILLA addresses test specifications and technical information, rather than the personnel data critical to the study undertaken by the Defense Nuclear Agency. Moreover, instances have arisen in which available historical documentation has revealed inconsistencies in vital factual data, such as the number of DOD participants in a certain project at a given shot or their locations and assignments at a given time. These inconsistencies in data usually occur between two or more documents, but occasionally appear within the same document. Efforts have been made to resolve these inconsistencies wherever possible, or to otherwise bring them to the attention of the reader.

ORGANIZATION AND CONTENT OF PLUMBBOB SERIES REPORTS

This volume details participation by DOD personnel in Shot PRISCILLA, the fifth detonation of the Operation PLUMBBOB nuclear weapons testing series. Seven other publications address DOD activities during the PLUMBBOB Series:

- Series volume: PLUMBBOB Series, 1957
- Multi-shot volume: Shots BOLTZMANN to WILSON, the First Four Tests of the PLUMBBOB Series
- Shot volume: Shot HOOD, a Test of the PLUMBBOB Series
- Multi-shot volume: Shots DIABLO to FRANKLIN PRIME, the Mid-series PLUMBBOB Tests
- Shot volume: Shot SMOKY, a Test of the PLUMBBOB Series
- Shot volume: Shot GALILEO, a Test of the PLUMBBOB Series

- Multi-shot volume: Shots WHEELER to MORGAN, the Final PLUMBBBOB Tests.

The volumes addressing the test events of Operation PLUMBBBOB have been designed for use with one another. The Series volume contains information which applies to those dimensions of Operation PLUMBBBOB which transcend specific events, such as historical background, organizational relationships, and radiological safety procedures. In addition, the Series volume contains a bibliography of works consulted in the preparation of Operation PLUMBBBOB reports.

The single-shot volumes describe DOD participation in Shots HOOD, SMOKY, and GALILEO. These events have been bound separately because they included substantial numbers of DOD participants. Each multi-shot volume combines shot-specific descriptions for several nuclear events, each involving smaller numbers of DOD personnel. The shot and multi-shot volumes contain bibliographies only of the sources referenced in each text. Descriptions of activities concerning any particular shot in the PLUMBBBOB Series, whether the shot is addressed in a single-shot volume or in a multi-shot volume, should be supplemented by the general organizational, and radiological safety information contained in the PLUMBBBOB Series volume.

The information in this report is supplemented by the "Reference Manual: Background Materials for the CONUS Volumes." The manual summarizes information on radiation physics, radiation health concepts, exposure criteria, and measurement techniques. It also lists acronyms and a glossary of terms used in the Nuclear Test Personnel Review reports addressing test events in the continental U.S.

Chapter 1 of this volume describes the physical setting of the PRISCILLA detonation and introduces the Desert Rock maneuvers and those Nevada Test Organization (NTO) diagnostic and scientific activities in which DOD personnel participated.

Chapter 2 describes the Exercise Desert Rock VII and VIII military projects conducted at Shot PRISCILLA, while chapter 3 describes various training activities, scientific experiments, and support missions conducted at PRISCILLA by the NTO in which DOD personnel took part. These chapters provide information about the number of DOD people involved in specific projects fielded at Shot PRISCILLA, the time spent by project personnel in the test area, and their positions relative to the point of detonation and areas of radioactivity before, during, and after the test.

Chapter 4 of this volume describes the radiological environment and safety procedures pertinent to Shot PRISCILLA, including isointensity contour maps illustrating the radiological contamination around ground zero following the detonation, and available shot-specific exposure data for individuals. Details of the overall radiation protection program at Operation PLUMBBOB are provided in the Series volume.

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LIST OF ABBREVIATIONS AND ACRONYMS

The following abbreviations and acronyms are used in this volume:

AEC	Atomic Energy Commission
AFB	Air Force Base
AFSWC	Air Force Special Weapons Center
AFSWP	Armed Forces Special Weapons Project
BJY	Buster-Jangle "Y"
CETG	Civil Effects Test Group
DOD	Department of Defense
FCDA	Federal Civil Defense Administration
HumRRO	Human Resources Research Office
LASL	Los Alamos Scientific Laboratory
NTO	Nevada Test Organization
NTS	Nevada Test Site
OCAFF	Office, Chief of Army Field Forces
REEC	Reynolds Electrical and Engineering Company
R/h	Roentgens-per-hour
UCRL	University of California Radiation Laboratory
USAF	United States Air Force
UTM	Universal Transverse Mercator
WETG	Weapons Effects Test Group

PRISCILLA

SHOT SYNOPSIS

AEC TEST SERIES: PLUMBBOB
DOD EXERCISES: Desert Rock VII and VIII
DATE/TIME: 24 June 1957, 0630 hours
YIELD: 37 kilotons
HEIGHT OF BURST: 700 feet (balloon shot)

Purpose of Test: Military Effects Test

DOD Objectives: (1) To study the effects of a nuclear weapon with known yield and characteristics on military equipment, materiel, structures, and ordnance
(2) To allow DOD personnel to observe a nuclear detonation
(3) To evaluate military equipment.

Weather: At shot-time the temperature was 17.5° C.; relative humidity, 29 percent; pressure, 909.5 mb; wind calm up to 5,000 feet mean sea level, increasing to about 45 knots at 43,000 feet mean sea level.

Radiation Data: The closest troops witnessed the detonation from trenches about 3,900 meters southwest of ground zero. Light to moderate fallout occurred northeast of ground zero. Troops touring the equipment display area approached as close as 500 meters to ground zero.

Participants: Armed Forces Special Weapons Project, Air Force Special Weapons Center and other Air Force personnel, Exercise Desert Rock Troops, Atomic Energy Commission, Los Alamos Scientific Laboratory, University of California Radiation Laboratory, Federal Civil Defense Administration, and Contractors.

CHAPTER 1

INTRODUCTION

Shot PRISCILLA was a test of a 37-kiloton nuclear device conducted at 0630 hours on 24 June 1957 at the Nevada Test Site (NTS), the U.S. Atomic Energy Commission (AEC) continental nuclear test area located northwest of Las Vegas. PRISCILLA was the fifth nuclear test of Operation PLUMBBOB, a series of 24 nuclear weapons tests and six safety experiments performed in Nevada between 24 April and 7 October 1957.

The PRISCILLA nuclear device was designed for the AEC by the Los Alamos Scientific Laboratory (LASL). The device was a previously tested nuclear weapon drawn from the nuclear arsenal, for which the yield and characteristics had already been evaluated. Military and scientific experiments were fielded to study the characteristics of the detonation. Some of these projects were conducted by LASL, and others by the University of California Radiation Laboratory (UCRL).

The primary objective of the PRISCILLA event was to correlate the yield and characteristics of the device with its effects on military equipment, materiel, structures, and ordnance. To fulfill this objective, the Armed Forces Special Weapons Project (AFWSP) of the Department of Defense (DOD) conducted 34 scientific projects at Shot PRISCILLA, making this shot one of the largest military effects tests ever conducted at the NTS. A number of other activities related to the conditions and phenomena produced by a nuclear detonation were also conducted during the PRISCILLA event. These included the Desert Rock

exercises, operational training projects, and Federal Civil Defense Administration (FCDA) projects (7).*

Most DOD participants at Shot PRISCILLA were involved in Exercise Desert Rock activities. More than 75 percent of the estimated 2,600⁺ DOD participants at this shot took part in the projects conducted by Exercise Desert Rock. In the Troop Observer and Indoctrination Program, more than 1,000 Army and Marine troops and official observers viewed the PRISCILLA detonation. This was the second largest observer group in the PLUMBBOB Series (35). The armed services fielded several projects at Shot PRISCILLA to evaluate military equipment and tactics. Similarly, operational training projects were conducted by the Air Force at PRISCILLA to test equipment and to familiarize personnel with the effects of a nuclear detonation.

The Federal Civil Defense Administration conducted projects to assess the effects of nuclear detonations on civilian populations and to evaluate Civil Defense emergency preparedness plans. Department of Defense participation in these projects was limited.

1.1 SETTING AND CHARACTERISTICS OF THE PRISCILLA DETONATION

The nuclear device tested at Shot PRISCILLA was suspended from a balloon 700 feet above the ground at UTM coordinates

*All sources cited in the text are listed alphabetically and numbered in the Reference List, appended to this volume. The number given in the citation in the text is the number of the source document in the Reference List.

⁺This number does not include support or staff personnel.

956729,* a location in Frenchman Flat near the middle of Frenchman Lake. Figure 1-1 shows the location of the PRISCILLA detonation in relation to other shots in the PLUMBBOB Series. Because the many military effects experiments conducted during PRISCILLA required several months of onsite preparation, PRISCILLA was the only event conducted in Frenchman Flat during Operation PLUMBBOB.

The PRISCILLA event was delayed for nine days. Originally scheduled for 15 June 1957, technical difficulties forced rescheduling of the event to 23 June 1957. Because of bad weather on that day, the shot was again postponed until the following morning. In the early morning hours of 24 June, personnel began positioning themselves for the event. The Desert Rock observers departed for the forward area where some stood in the open, more than 11 kilometers⁺ southwest of ground zero. Others crouched in four rows of trenches between 3,900 and 4,000 meters southwest of ground zero. Instruments and equipment for the many military effects and diagnostic projects ringed the area around ground zero. In the air, aircraft participating in operational training projects and Air Force Special Weapons Center (AFSWC) support activities positioned themselves for the detonation.

The PRISCILLA device was detonated at 0630 hours on 24 June 1957. Figure 1-2 shows the PRISCILLA detonation. One hour later, the time at which winds were measured, winds were calm at the surface, increasing to approximately 36 knots from the west-southwest at 40,000 feet (29). The nuclear cloud top rose to an

* Universal Transverse Mercator (UTM) coordinates are used in this report. The first three digits refer to a point on an east-west axis, and the second three refer to a point on a north-south axis. The point so designated is the southwest corner of an area 100 meters square.

⁺ Throughout this report, surface distances are given in metric units. The metric conversion factors include: 1 meter = 3.28 feet; 1 meter = 1.09 yards; and 1 kilometer = 0.62 miles.

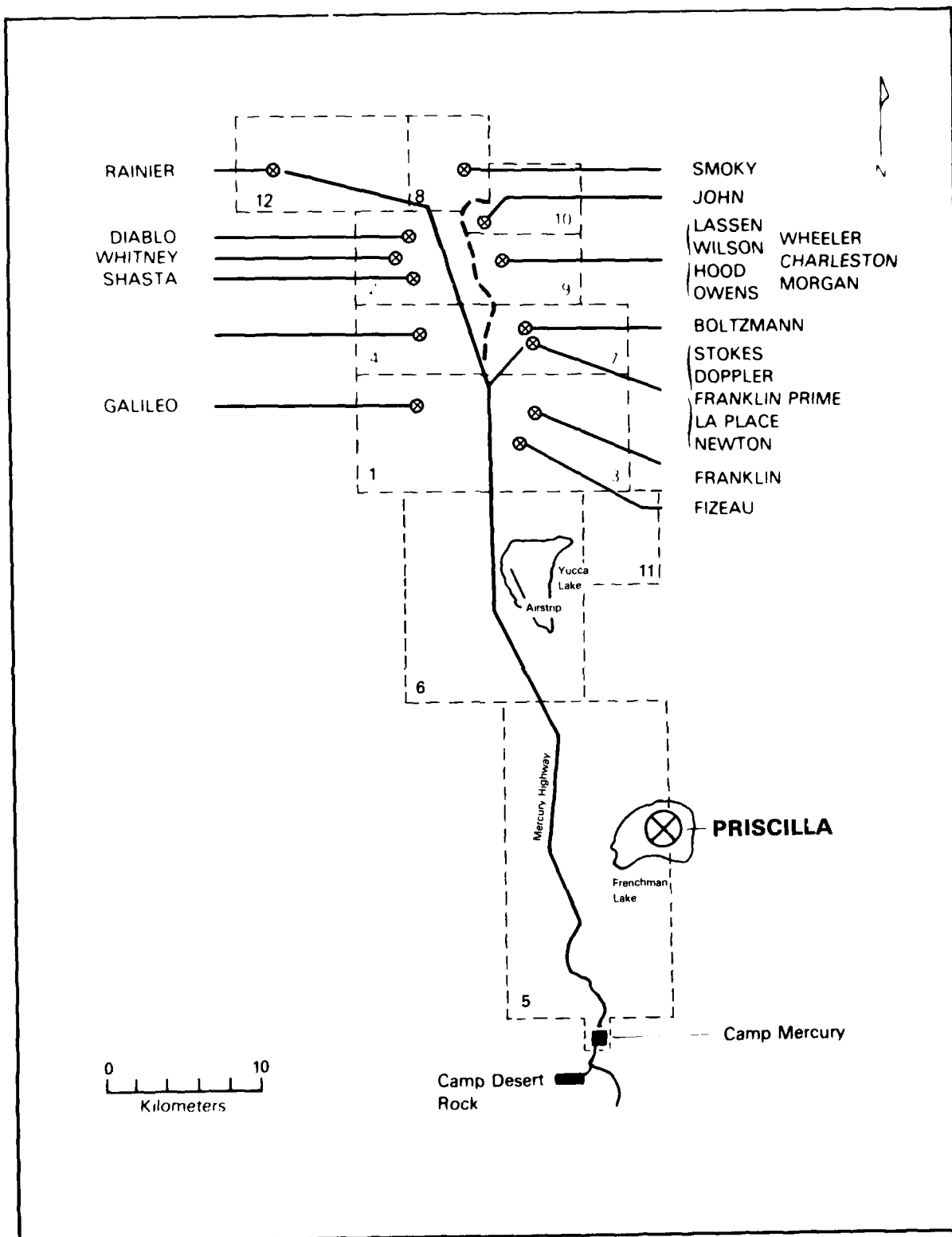


Figure 1-1: LOCATION OF SHOT PRISCILLA IN THE NEVADA TEST SITE, IN RELATION TO OTHER SHOTS IN THE PLUMBBOB SERIES

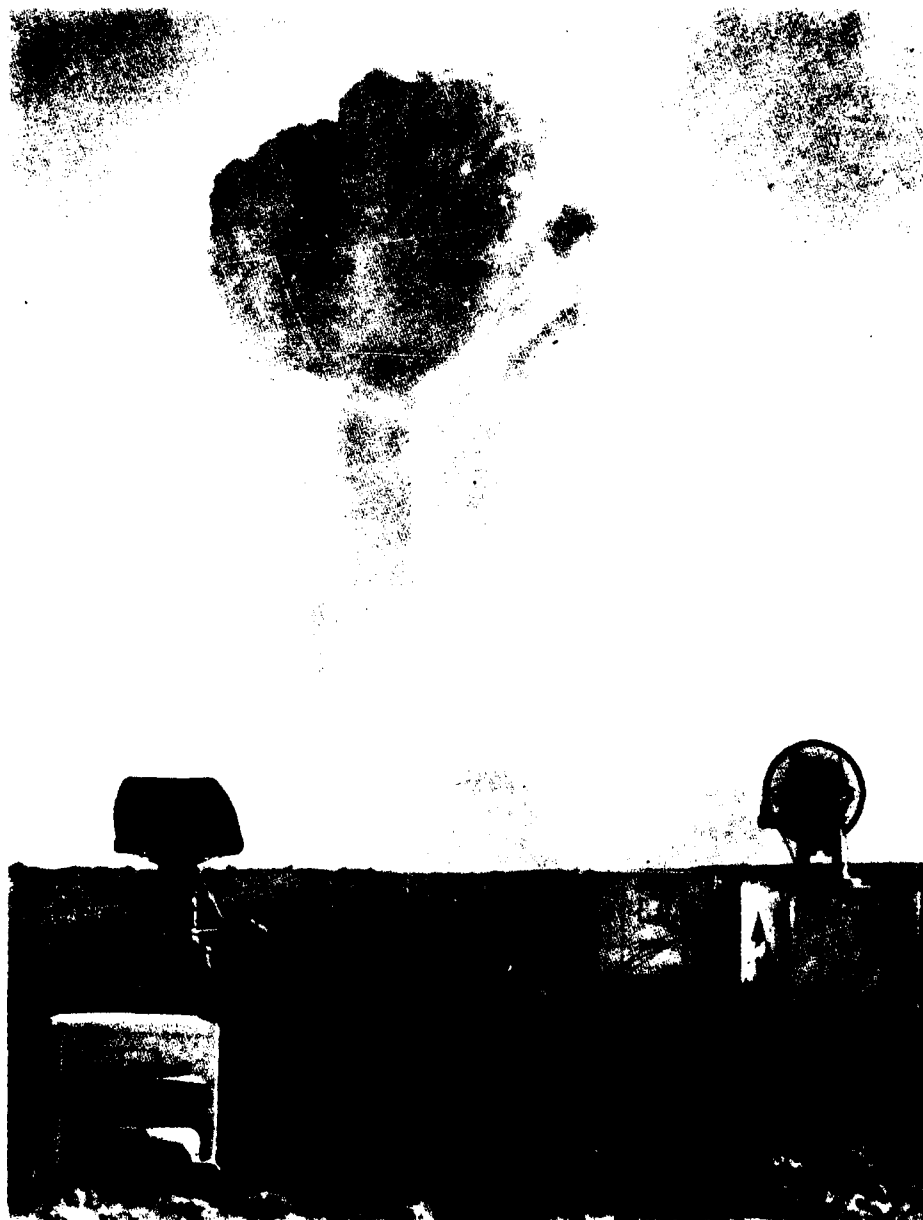


Figure 1-2: SHOT PRISCILLA, THE FIFTH NUCLEAR TEST OF THE PLUMBBOB SERIES

altitude of about 43,000 feet* and proceeded northeast from the point of detonation. Fallout occurred onsite northeast of ground zero and proceeded east toward Carp, Nevada, and to several communities in western and southern Utah (43).

Severe dust conditions delayed initial radiological surveys around ground zero after the detonation. This delay affected both the movement of the observers into the equipment display area and retrieval of experimental data from the areas around ground zero. When the Test Manager declared that the area was safe for entry, after completion of the initial survey, project participants proceeded with their activities as planned.

1.2 DEPARTMENT OF DEFENSE SCIENTIFIC, OPERATIONAL TRAINING, AND SUPPORT ACTIVITIES AT SHOT PRISCILLA

The Nevada Test Organization (NTO) was established for planning, coordinating, and conducting atmospheric nuclear weapons tests during Operation PLUMBBOB. All activities of the NTO were under the overall control of an AEC-appointed Test Manager, assisted by the Test Director. The NTO was comprised of personnel from the Atomic Energy Commission, the Department of Defense, and the Federal Civil Defense Administration, and included representatives from the AFSWP Weapons Effects Test Group (WETG), the LASL Test Group, the UCRL Test Group, and the FCDA Civil Effects Test Group (CETG). These test groups conducted 82 military effects and scientific projects at Shot PRISCILLA. About half of these projects included DOD participation. Three other projects were performed by Air Force personnel as part of the DOD operational training program.

*Altitudes and other vertical distances are given in feet. Altitudes are measured from mean sea level unless otherwise noted. Frenchman Lake is about 3,000 feet above mean sea level.

Personnel from DOD agencies and all four armed services participated in the experiments conducted by the four test groups, whose activities were coordinated by the Test Director. The largest DOD involvement was in the 34 military effects projects of the Weapons Effects Test Group. DOD personnel also assisted in four of the projects conducted by the other test groups, but DOD participation in these four projects was limited. Participants in the scientific and diagnostic experiments placed data-collection instruments around the point of detonation in the days and weeks preceding the scheduled event. After the detonation, when the Test Manager had determined that the radiological environment in the test area would permit limited access, participants recovered instruments and equipment. About 300 people took part in the projects conducted by the WETG, and another 20 assisted in those conducted by LASL, UCRL, and CETG (5; 6).

The three operational training projects, which involved about eight Air Force personnel, were designed to test service tactics and equipment and to train military personnel in the effects of a nuclear detonation. Two of these projects required aircrews to fly their aircraft in the vicinity of the Nevada Test Site at the time of the detonation to observe or photograph the fireball and the rise of the resulting nuclear cloud. The third project evaluated the accuracy of bomb damage assessment equipment inside an aircraft. These projects, like those of the test groups, were approved and coordinated by the Test Director.

In addition to those people involved in experiments and training, about 600 staff and support personnel provided necessary services to other participants at the test site.

One important support function during Shot PRISCILLA was provided by the Air Force Special Weapons Center, based at Kirtland Air Force Base (AFB), New Mexico. This group provided

air support to the Test Manager and to three test group projects. During Operation PLUMBBOB, AFSWC was comprised of units from the 4950th Test Group (Nuclear), including the 4926th Test Squadron (Sampling) and the 4935th Air Base Squadron. A total of 493 airmen and 23 officers of the 4950th were stationed at Indian Springs AFB, 38 kilometers southeast of the NTS (25). Support was also provided by the 4900th Air Base Group at Kirtland AFB. For PRISCILLA, AFSWC performed several missions, including aircraft control, security sweeps, cloud sampling, cloud tracking and penetration, radio relay, terrain surveys, and courier and transportation services.

To minimize exposure to ionizing radiation, radiation protection procedures were established by the Nevada Test Organization. Participants were to receive no more than three roentgens of whole-body gamma radiation for any 13-week period and no more than five roentgens of whole-body gamma radiation annually. To ensure these criteria were followed, access to contaminated areas was rigidly controlled, and project personnel recovering test instruments from highly contaminated areas were accompanied by radiological safety monitors. The monitors, who continuously checked the radiation intensity in the recovery area, had the authority to order a halt to recovery operations if intensities were too great or the length of time in the area was too long. Project personnel were issued film badges to wear at all times when in the test area. These film badges were collected, developed, and evaluated at regular intervals. Any individual whose accumulated exposure exceeded or would be expected to exceed the established limits was barred from further participation in project activities in the forward area. Although not implemented during PLUMBBOB, emergency evacuation procedures were prepared for all test events (57).

With one exception, the radiation protection procedures for the AFSWC aircrew and ground crew personnel were the same as those established for the NTO. As the single exception, cloud sampler pilots were allowed by the Test Manager to receive up to a total of 7.5 roentgens of gamma radiation annually. Complete decontamination, including showers and changes of clothing, was required of all aircrew members following each project mission, regardless of the exposure received on the flight. Aircraft were either decontaminated by washing or were isolated until radiation intensities had decayed to predetermined levels (57).

1.3 EXERCISE DESERT ROCK ACTIVITIES AT SHOT PRISCILLA

More than 1,700 military personnel, including Canadians, involved in Shot PRISCILLA participated in the projects fielded by Exercise Desert Rock VII and VIII, the Army testing and training program conducted during Operation PLUMBBOB. These projects included three troop observer and indoctrination projects and five technical service projects. Some Camp Desert Rock personnel also participated as observers (table 2-1).

The largest group of participants was comprised of 1,133 Army and Marine Corps observers. Another 604 individuals took part in five Exercise Desert Rock technical service projects. These projects involved exposing military equipment to a detonation to evaluate the damage sustained and testing military equipment and techniques for detecting nuclear bursts and fallout.

In addition to the Desert Rock exercise troops, about 2,000 support troops from various Army units maintained and operated Camp Desert Rock, providing transportation, communications, engineering, administrative, and security services. Of these Desert Rock support troops, some worked in the forward area of

the NTS to construct observer positions, lay communication lines, provide transportation and security, and assist in preparing the Desert Rock projects. Soldiers from the 50th Chemical Platoon served as radiological safety monitors for Desert Rock project personnel during nuclear test events.

Radiation protection procedures at Exercise Desert Rock, as well as those of the Nevada Test Organization, are detailed in the PLUMBBOB Series volume. The procedures were designed to minimize potential exposure to ionizing radiation while allowing participants to accomplish their project objectives. Camp Desert Rock support personnel and exercise participants were limited to no more than five roentgens of whole-body gamma radiation during any six-month period. The radiation protection procedures of Exercise Desert Rock included provisions for (8; 9):

- Maintaining minimum safe distances from nuclear detonations
- Enforcing protective procedures for personnel observing the detonation
- Controlling access to contaminated areas
- Monitoring individuals working in contaminated areas
- Issuing film badges to Desert Rock personnel and monitoring cumulative exposures
- Decontaminating all equipment and personnel leaving the test area after the detonation.

This report documents the activities of the Desert Rock troops and other DOD personnel who participated in Shot PRISCILLA. The activities of Desert Rock and NTO support personnel are detailed in the PLUMBBOB Series volume.

CHAPTER 2

EXERCISE DESERT ROCK VII AND VIII OPERATIONS AT SHOT PRISCILLA

Department of Defense (DOD) personnel participated in nine Exercise Desert Rock VII and VIII projects during Shot PRISCILLA. The principal concern throughout this chapter is with the Desert Rock activities that may have exposed participants to ionizing radiation before, during, and after the detonation. In all, more than 1,700 individuals took part in the Desert Rock exercises at PRISCILLA.

The discussion in this chapter focuses on the troops assigned to Exercise Desert Rock to participate in PRISCILLA. These individuals took part in one of two programs: the Troop Observer Indoctrination Program or the Technical Service Program. The Troop Observer Indoctrination Program, which involved 60 percent of the Desert Rock participants, was designed to orient armed services personnel to the effects of a nuclear detonation. The Technical Service Program was intended to test the effects of nuclear weapons on ordnance materiel, fortifications, structures, and equipment.

Detailed descriptions of project objectives and general project activities are contained in the PLUMBBOB Series volume that accompanies this report. The information contained in this chapter addresses only those project operations significant to Shot PRISCILLA.

Table 2-1 displays the Desert Rock programs and their subordinate projects conducted at Shot PRISCILLA, and includes the number of DOD personnel who took part in each.

Table 2-1: EXERCISE DESERT ROCK VII AND VIII PROJECTS, SHOT PRISCILLA

Program Type	Project	Title	Sponsor Agency	Participating Service	Estimated DOD Personnel
Troop Observer <i>Indoctrination</i>	50 2	Troop Observers	Army	Army; Navy	545
	52 2	Marine Corps Observers	Marine Corps	Marine Corps*	349
	53 3	Air Force Observer Training		Air Force	17
		Camp Desert Rock Observers		Army	105
Technical Service	50 3	Evaluation of Medium Range Detonation detection and Cloud Tracking Systems	Army Signal	Army Signal Research and Development Laboratories	30
	50 4	Evaluation of Water Decontamination Methods	Army	Army Engineer Research and Development Laboratories	5
	50 6	Test of Field Fortifications	Army Engineer Research and Development Laboratories	Army Engineer Research and Development Laboratories	7
	50 7	Test of Ordnance Material	Ballistics Research Laboratories	Ballistic Research Laboratories; Diamond Ordnance Fuze Laboratories	5
	50 8	Detection of Atomic Burst and Radioactive Fallout	Army Artillery	Army Artillery and Guided Missile School; Army Chemical School; Air Defense Board; Artillery Board; Air Weather Service	557

*Includes 311 participants from the 4th Marine Corps Provisional Atomic Exercise Brigade.

2.1 TROOP OBSERVER INDOCTRINATION PROJECTS AT SHOT PRISCILLA

A total of 1,133 observers witnessed Shot PRISCILLA as part of Exercise Desert Rock VII and VIII. The 662 observers of Project 50.2, Troop Observers, included 540 Army troops from various units, as well as five Navy, 107 Canadian, and 10 civilian personnel. Project 52.2, Marine Corps Observers, was comprised of 38 Marine Corps officers and enlisted men. Another 311 Marines from the 4th Marine Corps Provisional Atomic Exercise Brigade, which arrived at Camp Desert Rock on 20 June 1957 to participate in Shot DIABLO, were also afforded the opportunity to observe PRISCILLA. The observers watched the PRISCILLA detonation in two separate groups. One group was located in the open, approximately 11 kilometers southwest of ground zero. The other group was in four rows of trenches between 3,900 and 4,000 meters southwest of the detonation (UTM coordinates 930693). Among the observers in the trenches were 105 Camp Desert Rock personnel (28; 35; 49). Also included among the observers were 17 personnel from the Air Force, who were part of Project 53.3, Air Force Observer Training. Because no complete documentation based on actual activities exists, the exact number and unit assignment of the remaining observers at each location have not been determined (29; 35).

Preparations for the observer projects included positioning observer trenches and military equipment for the equipment display area. Locations for the trenches were based on Office, Chief of Army Field Forces (OCAFF) criteria for determining safe distances from ground zero, given the predicted and reasonable upper limit of the PRISCILLA yield, 40 kilotons. The average trench depth was five feet, so that a crouching person had a minimum of 24 inches of overhead protection. The military equipment was set up before shot-day by about ten people of the 526th Ordnance Company (35). The display area stretched from 230 to 2,300 meters south of ground zero. Figure 2-1 depicts the locations of the observer trenches and the equipment display area relative to ground zero.

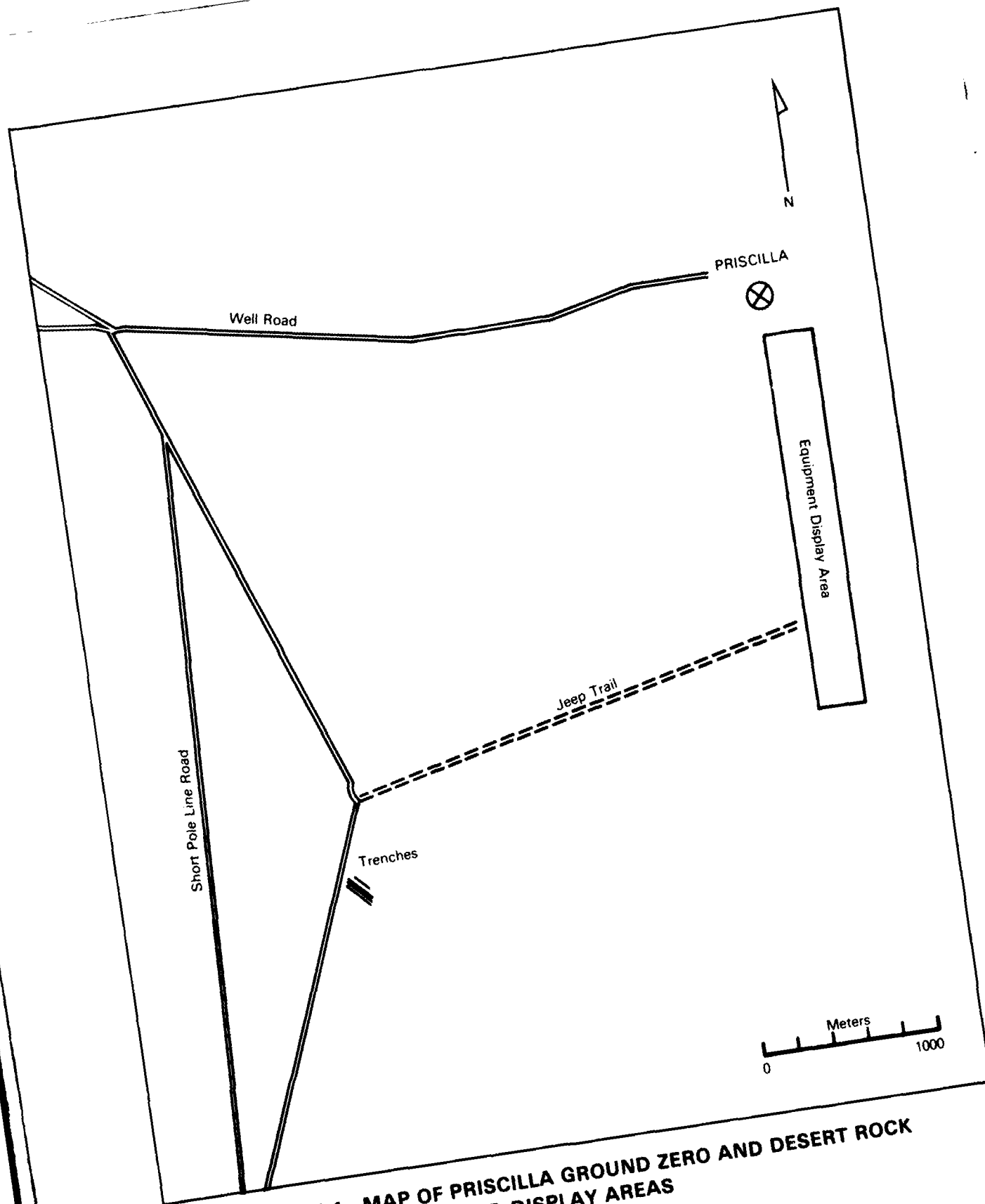


Figure 2-1: MAP OF PRISCILLA GROUND ZERO AND DESERT ROCK TRENCH AND DISPLAY AREAS

Additional Camp Desert Rock support personnel, including radiological safety monitors, military police, and transportation companies, supported the observer project and other Desert Rock projects.

The following description of planned observer activities is based on the PRISCILLA Operation Order and does not include the observers who were positioned in the open over 11 kilometers from the detonation.

The observers were presented with an eight-hour orientation course two days before the detonation. On the morning before the shot, the participants were briefed on observation procedures, and, that afternoon, were escorted on a tour of the Nevada Test Site.

In the early morning hours of shot-day, 24 June 1957, the observers assigned to trenches were organized into four march units, which departed Camp Desert Rock for the forward area in a 40-vehicle convoy. The planned times of departure from Camp Desert Rock and arrival at the observation positions for each unit were as follows (34):

<u>MARCH UNIT</u>	<u>DEPARTURE</u>	<u>ARRIVAL</u>
1	0231	0305
2	0244	0318
3	0257	0331
4	0310	0345

After unloading the observers, the drivers took their empty trucks back to a parking area, approximately nine kilometers southwest of ground zero (34).

One hour before the detonation, all northbound traffic into the forward area was stopped except for emergency traffic cleared by the Test Director. Loudspeakers announced the 30-minute

warning and the observers were ordered into the trenches. All unnecessary electronic equipment, including radios and vehicles, was turned off. Radio silence was ordered 15 minutes before the detonation. A siren announced the ten-minute warning. Loudspeakers announced the five-minute warning and gasoline engines were turned off. Persons without dense goggles turned their backs toward ground zero at this time and were not to turn around until after the initial flash. One minute before the detonation the AEC Control Point announcer started to broadcast the countdown. Those observers in trenches crouched, closed and covered their eyes; those supplied with goggles put them on (35).

One Armed Forces Special Weapons Project (AFSWP) participant described Shot PRISCILLA as follows: "H hour and what an hour. . . .the thermal wave was very intense and the shock wave upset a number of people who were not braced for it." The ground shock reportedly caused a portion of one observer trench to collapse, partially burying some observers. These individuals were promptly dug out by their companions in the trench area.

After the detonation, three two-man radiological survey teams from the 50th Chemical Platoon began to establish the 0.02 R/h* and the 5 R/h lines in the equipment display area. The 5 R/h line was established about 500 meters from ground zero.

The observer troops moved out of the trenches approximately two hours after the detonation, boarded the trucks, and were driven to the equipment display area. They dismounted and walked through the display area. Figure 2-2 shows the type of damage sustained by vehicles in the PRISCILLA equipment display. Accompanied by a member of the Exercise Desert Rock instructor

*Roentgens per hour



Figure 2-2: EXERCISE DESERT ROCK OBSERVERS VIEW DAMAGE EFFECTS TO MILITARY
VEHICLES AFTER SHOT PRISCILLA

group, the observers proceeded no further than the 5 R/h line within the display area. At about 0830 hours, the observers reboarded the trucks and were transported back to Camp Desert Rock. In all, they spent approximately six hours in the forward area (34).

2.2 TECHNICAL SERVICE PROJECTS AT SHOT PRISCILLA

As listed in table 2-1, five technical service projects were conducted at Shot PRISCILLA. A total of 604 DOD personnel took part in these projects. With the exception of Project 50.4, Evaluation of Water Decontamination Methods, and Project 50.6, Protection Afforded by Field Fortifications, the same individuals who conducted the technical service projects at Shot PRISCILLA also performed them at other PLUMBBOB shots. Therefore, project participants from projects 50.3, 50.7, and 50.8 were active at the Nevada Test Site (NTS) both before and after Shot PRISCILLA.

Project 50.3, Evaluation of Medium Range Detonation-detection and Cloud Tracking Systems, was fielded by a detachment of 30 people from the Army Signal Research and Development Laboratories, Fort Monmouth, New Jersey. The project was designed to test the capacity of Army radar equipment for detecting nuclear detonations and tracking radioactive clouds and to examine Army fallout prediction methods. The 30 people comprised two teams: a radar section, located about 15 kilometers northwest of ground zero, and a Fallout Prediction Team who operated out of an M-109 equipment mobile van situated next to the weather station at Camp Mercury. The fallout team was supplemented by a meteorological team located south of Alamo, Nevada, approximately 50 kilometers east of Frenchman Flat (13; 46; 48).

Project 50.4, Evaluation of Water Decontamination Methods, was conducted by the Army Engineer Research and Development Laboratories only during Shot PRISCILLA. The objective of the project was to study water solubility characteristics of radioactive debris and to evaluate methods for removing these contaminants from water. Field operations began on 3 June and ended 25 July 1957. The evening before PRISCILLA, five people from the Sanitary Engineering Branch, Army Engineer Research and Development Laboratories, placed pans filled with water at ten stations from 400 meters to 3,200 meters north, northeast, east, and southeast of ground zero. One to three hours after the shot, the 50th Chemical Platoon (Service) radiological safety personnel monitored each of the ten stations, obtaining the following radiation level readings (39):

<u>Station</u>	<u>Azimuth/Distance from GZ</u>	<u>Time</u>	<u>Gamma Intensity (R/h)</u>
1	130°/2490 m.	0810	.005
2	135°/1370 m.	0840	.032
3	90°/1370 m.	0847	.034
4	90°/3140 m.	0853	.002
5	60°/1460 m.	0900	.020
6	45°/2560 m.	0904	.180
7	30°/1830 m.	0907	.150
8	38°/1370 m.	0910	.300
9	4°/1370 m.	0913	.075
10	4°/2740 m.	0917	.003

The highest radiation intensities were at stations 6, 7, and 8, which were situated northeast of ground zero, the direction taken by the cloud following the detonation of Shot PRISCILLA.

Ten to 12 hours after the shot, project personnel conducted another survey, and two days after the shot, the fallout in the water pans was monitored, as shown in figure 2-3, and then collected for analysis. After the two-day period, soil samples also were collected around ground zero and subsequently analyzed for radioactivity and solubility.



Figure 2-3: PARTICIPANT FROM ENGINEER RESEARCH AND DEVELOPMENT LABORATORIES DETERMINES THE RADIATION CONTENT OF CONTAMINATED WATER DURING PROJECT 50.4, EVALUATION OF WATER DECONTAMINATION METHODS

Project 50.6, Test of Field Fortifications, was designed to determine the protection afforded against nuclear weapons effects by various types of field fortifications. The project, performed by about seven people from a detachment of the Army Engineer Research and Development Laboratories, was conducted in conjunction with AFSWP Field Command Weapons Effects Test Group Project 2.4, Shielding Studies. Twenty-seven fortifications were constructed prior to the PRISCILLA detonation by the 84th Engineer Battalion. The fortifications consisted of five machine-gun emplacements, 20 foxholes of various construction, and two hasty shelters, and were positioned from 435 meters to approximately 900 meters southwest of ground zero. Pressure-time gauges were installed in the machine-gun emplacements and in five of the foxholes. The personnel from Project 2.4 also placed instruments for this project, while members of another AFSWP project, 4.1, placed a pig in the entrance of each machine-gun emplacement. Available documentation does not explain the procedures of the project personnel following the detonation (22).

Project 50.7, Test of Ordnance Material, was intended to test items of ordnance under the blast, thermal, and radioactive conditions created by nuclear detonations. Approximately five individuals from the Ballistic Research Laboratories fielded Project 50.7. The equipment tested at Shot PRISCILLA was limited to rocket and shell fuses and hand grenades. The ordnance equipment was buried in shallow trenches from eight to 12 inches deep and at distances of 360 meters, 720 meters, and 1,050 meters from ground zero. At an unspecified time after the shot, five people spent about two hours recovering the equipment, which was later sent to Diamond Ordnance Fuze Laboratories for analysis (12).

Project 50.8, Detection of Atomic Burst and Radioactive Fallout, was sponsored by the Army Artillery and Guided Missile School, with support from the Army Chemical School, the Air

Defense Board, the Artillery Board, and the Air Weather Service. The purpose of the project, which involved 557 people, was to determine how well equipment found in a typical Army unit could determine the location, height of burst, and yield of a nuclear detonation. The equipment was positioned before the detonation by a team of 268 people at 19 different locations, most of which were located offsite. The closest locations were approximately four kilometers west and northwest of ground zero.

As part of this project, a B-26 aircraft with two people from George AFB tested the attenuation of Nike missile control signals when operating in or beyond a nuclear cloud. Beginning 30 minutes before the detonation, the plane flew an oval race-track course north of ground zero at an altitude of 15,000 feet. After the shot, the pilot positioned the aircraft so that the radioactive cloud was between the aircraft and an equipment site located at UTM coordinates 922632, to monitor the Nike control signals (34; 35).

Air radiological surveys by four helicopter teams were scheduled to determine the PRISCILLA fallout pattern. Approximately 30 minutes following the detonation, the four helicopters were to depart from the Desert Rock Decontamination Station in Yucca Flat and fly around the Frenchman Flat area at altitudes of 200 to 1,000 feet taking aerial radiation readings. Because of severe dust conditions, it is unlikely these helicopters took off at the scheduled time (34).

CHAPTER 3

NEVADA TEST ORGANIZATION OPERATIONS AT SHOT PRISCILLA

During Shot PRISCILLA, Department of Defense (DOD) personnel performed a variety of tasks, including scientific and military effects experiments, training projects, and support activities. DOD personnel were involved in 35 military effects projects conducted by the Armed Forces Special Weapons Project (AFSWP) Field Command Weapons Effects Test Group. DOD participation in scientific experiments included one of the 14 projects of the Los Alamos Scientific Laboratory (LASL) Test Group, one of the four projects fielded by the University of California Radiation Laboratory (UCRL) Test Group, and three of the 30 projects conducted by the Federal Civil Defense Administration Civil Effects Test Group (CETG). In addition to the scientific and diagnostic experiments, three DOD operational training projects were conducted by the Air Force during PRISCILLA. Finally, Air Force Special Weapons Center (AFSWC) personnel flew support missions for the test groups and the Test Manager.

These activities involved more than 300 project personnel, more than 500 AFSWC air and ground personnel, and perhaps an additional 100 DOD personnel working for the support units of the Nevada Test Organization. In contrast, the Desert Rock projects addressed in chapter 2 involved approximately 1,700 DOD personnel.

Detailed descriptions of project objectives and general project activities are contained in the PLUMBBOB Series volume. The information contained in this chapter addresses only those project operations significant to Shot PRISCILLA.

3.1 FIELD COMMAND WEAPONS EFFECTS TEST GROUP PROJECTS AT SHOT PRISCILLA

The Weapons Effects Test Group of AFSWP Field Command performed 35 projects at Shot PRISCILLA. Table 3-1 lists the AFSWP projects with DOD participation, the participating organizations, and, where possible, the estimated numbers of DOD people involved. The estimates are based on a knowledge of fielding and recovery procedures, or on the Test Director's schedule of events. Because, in most cases, the same people performed both pre- and postshot activities, estimates reflect the maximum number of DOD people who would have been involved in the project.

Project 1.1, Basic Airblast Phenomena, was fielded to obtain data on overpressure and dynamic pressure values as a function of time and distance from ground zero. Performance of various pressure gauges and measurement devices and techniques was also evaluated. An additional objective particular to Shot PRISCILLA was to obtain free-field blast measurements for various agencies conducting equipment and structural tests during the event. Before the shot, Ballistic Research Laboratories personnel installed 38 self-recording pressure-time gauges at 16 stations along a blast line west of the PRISCILLA ground zero. About three project personnel and a radiation monitor, all suited in protective clothing and air purification respirators, spent about four hours recovering the gauges in areas of low radiation intensity on shot-day. They spent the next two days collecting the remaining gauges, as radiation levels in the area declined to permissible levels (15).

Project 1.3, Airblast Phenomena in the High-pressure Region, was designed to measure the extremely high overpressures and dynamic pressures at close range to the detonation, record their onset, and relate these pressures to time and distance from ground zero.

**Table 3-1: FIELD COMMAND WEAPONS EFFECTS TEST GROUP
PROJECTS, SHOT PRISCILLA**

Project	Title	Participating Agency	Estimated DOD Personnel
1.1	Basic Airblast Phenomena	Ballistic Research Laboratories	4
1.3	Airblast Phenomena in the High Pressure Region	Stanford Research Institute	8
1.4	Ground Acceleration, Stress, and Strain at High Incident Overpressures	Stanford Research Institute	7
1.5	Ground Motion Studies at High Incident Overpressures	Sandia Corporation	7
1.7	Loading on Simulated Buried Structures at High Incident Overpressures	Air Research and Development Command	6
2.1	Soil Activation by Neutrons	Army Chemical Warfare Laboratories	3
2.3	Neutron Flux from Selected Nuclear Devices	Army Chemical Warfare Laboratories	3
2.4	Neutron and Initial-gamma Shielding	Army Chemical Warfare Laboratories	3
2.6	Evaluation of Radiac Instruments	Army Signal Research and Development Laboratories	4
2.7	Radio-wave Attenuation Studies	Naval Research Laboratory	3
2.8	Evaluation of Military Radiac	Naval Material Laboratory	3
3.1	Blast Loading and Response of Underground Concrete Arch Protective Structures	Naval Civil Engineering Laboratory; Army Waterways Experiment Station	8
3.2	Evaluation of Buried Conduits as Personnel Shelters	Navy Bureau of Yards and Docks; Naval Civil Engineering Laboratory	8
3.3	Evaluation of Earth-covered Prefabricated Ammunition Storage Magazines as Personnel Shelters	Navy Bureau of Yards and Docks; Naval Civil Engineering Laboratory	*
3.4	Blast Effects on Existing UPSHOT-KNOTHOLE and TEAPOT Structures	Armour Research Foundation; Air Force Special Weapons Center	11
3.5a	Isolation of Structures from Ground Shock	Stanford Research Institute	9
3.6	Full Scale Field Tests of Dome and Arch Structures	Air Force Special Weapons Center; American Machine and Foundry Company	6
3.7	Instrumentation of Structures for Airblast and Ground Shock Effects	Ballistic Research Laboratories	*
3.8	Soil Survey and Backfill Control in Frenchman Flat	Army Engineer Waterways Experiment Station	4
4.1	Effects of Nuclear Detonations on a Large Biological Specimen (Swine)	Walter Reed Army Institute of Research	179
4.2	Evaluation of Eye Protection Afforded by an Electromechanical Shutter	Wright Air Development Center	10
4.3	Secondary Missiles Generated by Nuclear-produced Blast Waves	Civil Effects Test Group Project 33.2 Personnel	*

* Unknown

**Table 3-1: FIELD COMMAND WEAPONS EFFECTS TEST GROUP
PROJECTS, SHOT PRISCILLA (Continued)**

Project	Title	Participating Agency	Estimated DOD Personnel
5.1	In-flight Structural Response of the HSS-1 Helicopter to a Nuclear Detonation	Navy Bureau of Aeronautics	14
5.4	In-flight Structural Response of the A4D-1 Aircraft to a Nuclear Detonation	Navy Bureau of Aeronautics; Douglas Aircraft Company	*
5.5	In-flight Structural Response of the F-89D Aircraft to a Nuclear Detonation	Wright Air Development Center; Northrop Aircraft, Inc.	*
6.1	Minefield Clearance by Nuclear Weapons Detonations	Army Engineer Research and Development Laboratories	8
6.2	Measurement of the Magnetic Component of the Electromagnetic Field Near a Nuclear Detonation	Diamond Ordnance Fuze Laboratories	6
6.2a	Measurement of the Effects of Nuclear Radiation on Semi-conductor Devices	Diamond Ordnance Fuze Laboratories	3
6.3	Attenuation of Electromagnetic Radiation Through an Ionized Medium	Naval Air Development Center	*
6.4	Accuracy and Reliability of the Short-baseline NAROL System	Air Force Cambridge Research Center	*
8.1	Thermal Protection of the Individual Soldier	Army Quartermaster Research and Engineering Command	9
8.2	Prediction of Thermal Protection of Uniforms and Thermal Effects on Standard-reference Material	Naval Material Laboratory	10
8.3a	Performance of a High-speed Spectrographic System	Naval Radiological Defense Laboratory	4
8.3b	Instrumentation for Measuring Effects Phenomena Inside the Fireball	Wright Air Development Center	4
9.1	Support Photography	Armed Forces Special Weapons Project; Air Force Lookout Mountain Laboratory; Military Air Transport Service	3

* Unknown

This project was fielded only at Shot PRISCILLA. Field operations for Project 1.3 were performed at the same time and by the same people as for Project 1.4, Project 3.5a, and for the instrumentation phase of Project 1.7. A common recording shelter was used, and the data channels were intermingled. Common cable trenches were used in most cases. Forty-seven gauges were placed at 14 stations located 23 to 1,350 meters from ground zero. An eight-man crew from the Stanford Research Institute spent two months in the field before the shot. Cable trenching, performed by an AEC contractor, probably took three people approximately two weeks. It is estimated that three to four AEC contractor personnel spent two months preparing the site and installing the gauges. Recovery of the gauges probably took three people eight to ten hours. Documentation does not indicate which of these project members were DOD personnel (51).

Project 1.4, Ground Acceleration, Stress, and Strain at High Incident Overpressures, was designed to measure the underground pressures at various depths as exerted by a blast wave at the surface, especially in the region close to ground zero. Field operations for Project 1.4 were performed by the same personnel at the same time as those for Project 1.3 and Project 3.5a, and with instrumentation for Project 1.7. Seven members of the Stanford Research Institute fielding party were on location for eight weeks before the shot, calibrating and placing the gauges and backfilling the holes. The gauges that measured horizontal acceleration, stress, and strain were placed at 230 meters and 320 meters from ground zero and at various depths up to 50 feet. The gauges that measured vertical acceleration and stress were placed 140, 170, 200, 230, 260, and 410 meters from ground zero at depths of five to ten feet. The records were recovered from the recording shelter on the afternoon of shot-day. The recovery operation required five participants to be in a 0.001 R/h radiation field for about 20 minutes. It is not known if all of the personnel were from the DOD (52).

Project 1.5, Ground Motion Studies at High Incident Overpressures, was fielded to obtain data on ground movements caused by the shock waves following a nuclear detonation. Field operations were conducted concurrently with those of Projects 1.3, 1.4, and 3.5a, and with the instrumentation phase of Project 1.7. Part of the study included observation of acceleration in buried vertical reinforced concrete structural elements to provide information that could be correlated with ground movement data. The Project 1.5 instrument array consisted of five stations, located 23, 200, 260, 320, and 410 meters from ground zero. Additional permanent-displacement data from the vicinity of ground zero were derived from similar surveys on a grid in the test area (42). An estimated seven project personnel spent eight weeks fielding the experiment prior to shot-day.

At an unspecified time on shot-day, two or three project personnel, accompanied by a radiation monitor, spent about four hours retrieving some of the gauges located at the stations farthest from ground zero. They retrieved the remaining gauges as radiation levels permitted over the next two days. It is not known if all of these personnel were from the Department of Defense.

Project 1.7, Loading on Simulated Buried Structures at High Incident Overpressures, was intended to measure and evaluate the ground pressures transmitted to large steel drums buried at various depths close to ground zero. The project was planned and carried out by personnel of the Structural Research Laboratory of the University of Illinois, under contract to the Air Research and Development Command. Dynamic instrumentation and soil-testing services were furnished by the Ballistic Research Laboratories, the Stanford Research Institute, and the Waterways Experiment Station of the Army Corps of Engineers. The instrumentation phase of this experiment was conducted concurrently with Projects 1.3, 1.4, and 3.5a.

Field operations consisted of burying 68 test-device drums in three trenches. The drums were 0.6 meters long and 0.6 meters in diameter, with a diaphragm fitted on each end to yield two sets of data per drum. Six project personnel excavated the three trenches at ground ranges of 230, 310, and 410 meters from ground zero. Each trench was one meter deep at each end, increasing to seven meters in the middle. Two weeks after the detonation, two AEC and two project personnel each spent an estimated 15 hours excavating the drums (16).

Project 2.1, Soil Activation by Neutrons, was designed to measure neutron-induced radioactivity in the soil. The data were to be used to predict the radiological hazard from such soil activation. Approximately two project personnel spent an estimated two hours placing markers to indicate where a helicopter team was to place necessary instrumentation. After the detonation, the helicopter survey team, consisting of three men, placed ionization chambers on tripods on the ground at distances between 370 meters and 1,100 meters from ground zero. The surveys were made 25, 50, 75, and 100 minutes after the detonation (37).

Project 2.3, Neutron Flux from Selected Nuclear Devices, was designed to measure the output of neutrons from the PRISCILLA nuclear device and to determine the energy spectrum of the neutrons and the distances that they traveled in the air. Neutron measurements were made as a function of distance from the point of detonation. Of prime importance to the investigation was the determination of the number and energy of the neutrons. The measurements involved the placement of ten arrays of small disks of selected materials that detected the neutrons in each of several energy ranges.

Since neutron-induced radiation decays rapidly for some isotopes, it was essential to return the detectors to the laboratory for analysis as soon after the shot as possible. To aid in this prompt retrieval, the five or six different types of neutron detectors at each of ten stations were all attached to a cable laid along the ground, starting 340 meters west of ground zero and continuing west for 470 meters (47). A few minutes after the PRISCILLA detonation, two project personnel and a radiation monitor, all clothed in radiation protection gear, took a pickup truck to the far end of the cable, about 900 meters west of ground zero. While the monitor measured the radiation and clocked their time in the area, the project personnel quickly secured the end of the cable to the back of the pickup truck. Then all three climbed back aboard the truck and rapidly drove out of the area, dragging the neutron-detection arrays behind them. Once safely beyond the radiation zone, they stopped the truck, disconnected the detectors from the cable, and put them in the sealed storage containers in the truck. After proceeding through decontamination, they took the samples to the laboratory at Camp Mercury for analysis.

Project 2.4, Neutron and Initial-gamma Shielding, was designed to study several types of field fortifications and underground shelters for their effectiveness in shielding or blocking out nuclear radiation. The studies were linked to the shelter experiments of Program 3 and Exercise Desert Rock, Project 50.6, Test of Field Fortifications. Several agencies cooperated on this project. Executive responsibility, including detailed planning, field instrumentation, and reporting of results, was vested in the Army Chemical Warfare Laboratories; ordnance was the responsibility of the Ballistic Research Laboratories; field fortifications were the responsibility of the Army Engineer Research and Development Laboratories for Project 50.6; and gamma film-packet measurements were the responsibility of Army Signal Research and Development Laboratories (35; 53). Two

or three project personnel recovered the detectors at an unspecified time on shot-day, as radiation levels permitted.

Project 2.6, Evaluation of Radiac Instruments, tested the ability of a newly developed gamma-neutron dosimeter and a new beta-gamma ion chamber ratemeter to accurately detect and measure gamma and neutron radiation. In evaluating the neutron dosimeter system, tissue-equivalent tactical neutron dosimeters and standard radiac meters were exposed to initial nuclear radiation from Shot PRISCILLA. The readings were compared to those made with chemical dosimeters and with National Bureau of Standards film dosimeters.

Project personnel attached dosimeters and film packs to plywood slats placed within linen-reinforced Bakelite tubes eight centimeters in diameter and 1.2 meters long. They placed the tubes at eight locations from 1,330 meters to 1,840 meters west of ground zero. Three people spent half a day surveying and installing each of the eight stations for this project before the shot. About four hours after the detonation, four people spent approximately one hour recovering the dosimeters (19).

Project 2.7, Radio-wave Attenuation Studies, was fielded to study the interference effects of high levels of radiation on radio transmissions and radar operations. A receiver was placed in Building 400, located about 20 kilometers from ground zero, and an antenna and transmitter were placed about five kilometers from ground zero, probably by three people two days before the detonation. Two or three personnel removed the antenna used in this project within a few days after the detonation so that it could be used again at Shot HOOD (33).

Project 2.8, Evaluation of Military Radiac, evaluated the accuracy of several types of Navy radiac equipment in measuring radiological hazards in the field under anticipated conditions of

nuclear warfare. The experimental equipment consisted of one masonite phantom, or dummy human, loaded with selectively shielded standard depth-dose detectors and dosimeters, and one masonite phantom containing two ratemeters. Two hours after the detonation of Shot PRISCILLA, the experimental equipment was transported into the field and located at positions where the field distribution was fairly uniform and the field strength as measured in the air was between 10 and 20 R/h. An estimated two project personnel and a radiation monitor, all wearing film badges, protective clothing, and air purification respirators, placed the phantoms in the field. The phantoms were recovered 52 hours after placement (24).

Project 3.1, Blast Loading and Response of Underground Concrete Arch Protective Structures, was designed to evaluate the effects of a kiloton-range nuclear airburst on buried reinforced-concrete arch structures located near ground zero. The project was planned and carried out jointly by the Naval Civil Engineering Laboratory and the Army Engineer Waterways Experiment Station. The Ballistic Research Laboratories and the Army Chemical Warfare Laboratories furnished much of the instrumentation. An estimated five people spent ten days placing the instruments in the structures. Recovery was probably accomplished within a week of shot-day by eight project personnel (27).

Project 3.2, Evaluation of Buried Conduits as Personnel Shelters, was designed to determine the degree of protection that could be afforded to personnel by steel and concrete conduits buried at various depths and located various distances from ground zero. The pretest planning and overall development of the project was accomplished by the Bureau of Yards and Docks, with fielding and recovery assistance by personnel of the Naval Civil Engineering Laboratory. The following agencies, in connection

with the following projects, made essential contributions to Project 3.2:

- Army Chemical Warfare Laboratories: Project 2.4, Neutron and Initial-gamma Shielding
- Ballistic Research Laboratories: Project 3.7, Instrumentation of Structures for Airblast and Ground Shock Effects
- Army Engineer Waterways Experiment Station: Project 3.8, Soil Survey and Backfill Control in Frenchman Flat
- Air Force Lookout Mountain Laboratory: Project 3.1, Support Photography
- Lovelace Foundation for Medical Education and Research: Project 33.2, Missiles Secondary to a Nuclear Blast, and Project 33.5, The Internal Environment of Underground Structures Subjected to Nuclear Blast - the Concurrence of Dust.

Estimates indicate that eight people spent about 12 days preparing for the project. They installed pressure-time gauges, accelerometers, film badges, and dosimeters, and performed sand density tests within the various structures. Sometime within two weeks after the detonation, approximately four people spent six days recovering film badges, dosimeters, and data from pressure-time gauges and accelerometers (3).

Project 3.3, Evaluation of Earth-covered Prefabricated Ammunition Storage Magazines as Personnel Shelters, evaluated three basic components of a personnel shelter to determine the amount of protection they afforded against blast and radiation effects. The agencies that planned, fielded, and contributed data and instrumentation for this project were the same as those described under Project 3.2, Evaluation of Buried Conduits as Personnel Shelters. The structures being tested were 350 meters and 410 meters from ground zero. Estimates indicate that recovery operations probably took place within a month following shot-day as radiation levels allowed. Recovery personnel were suited in protective clothing and air purification respirators (3; 4).

Project 3.4, Blast Effects on Existing UPSHOT-KNOTHOLE and TEAPOT Structures, was conducted as eight individual experiments. Seven of the tests used structures remaining from the 1953 UPSHOT-KNOTHOLE and 1955 TEAPOT atmospheric nuclear weapons test series, while the eighth required new construction. The general objective was to obtain blast loading and structural response data during the PRISCILLA event. The Armour Research Foundation performed the experiment, which was monitored by the Structures Division, Research Directorate, AFSWC, Kirtland AFB, New Mexico. The new items tested were a series of concrete panels with 12 types of special coatings and refractories. Several precast panels were exposed at each of three ground-range locations 18, 90, and 240 meters from ground zero. The postshot survey, photography, and recovery of instrumentation from the seven previously existing structures were accomplished by an estimated eight people one week after the area had been declared safe. An additional three project personnel were estimated to have spent four days analyzing and photographing the various concrete test panels (18).

Project 3.5a, Isolation of Structures from Ground Shock, was to test the value of two forms of special backfill in isolating or protecting underground structures and their contents from the physical effects of shock waves produced by the detonation. Stanford Research Institute was responsible for the general planning, instrumentation, and excavation of the structures. The instrumentation phase of this project was performed concurrently with Projects 1.3, 1.4, and 1.7. Two test structures and one comparison structure were used. Onsite, the contractor excavated three holes, each 1.6 meters in diameter and 4.5 meters deep, placed test structures in the holes, and backfilled and compacted the soil. Installation of gauges took an estimated nine people four days. The test equipment was not recovered after the detonation, because it was to be used in a subsequent test. The structures remained in place until the spring of 1961, when it

was evident that another large above-ground detonation would not be fired over the buried structures (54).

Project 3.6, Full-scale Field Tests of Dome and Arch Structures, tested above-ground domed and arched structures and their blast doors for ability to withstand blast forces. Ten concrete and aluminum structures, situated between 360 meters and 620 meters from ground zero, were used.

AFSWC and the American Machine and Foundry Company fielded the project, and the Ballistic Research Laboratories furnished pressure instrumentation. An estimated two or three people recovered instrumentation and gauges in five or six days and three people inspected the project and took photographs for two days within two weeks of the shot (17).

Project 3.7, Instrumentation of Structures for Airblast and Ground Shock Effects, provided electronic and automatic recording instrumentation to measure the blast wave and ground shock strengths for the shelters used in Projects 3.1, 3.2, 3.3, 3.6, and CETG Projects 33.2 and 33.5. The instrumentation was placed and recovered by project personnel in conjunction with those projects (41).

Project 3.8, Soil Survey and Backfill Control in Frenchman Flat, was designed to study the specific composition and physical characteristics of the natural soil in the Frenchman Flat area of the Nevada Test Site (NTS). Four members of the Army Engineer Waterways Experiment Station fielded the project. The soil test data were required for Projects 1.4, 1.5, 1.7, 3.1, 3.2, 3.3, 3.5, 3.6, 6.1, and 30.1, before, during, and after the various project installations. The project survey was divided into three preshot phases and one postshot phase. The three preshot phases obtained different soil samples from soil excavated for various project installations. These samples were sent to the Waterways

Experiment Station for analysis. The postshot phase consisted of obtaining samples from four of the project installation areas. Most samples were obtained by the various contractors from the projects mentioned above. Four persons fielded Project 3.8 at the NTS for approximately four weeks before the detonation. Postshot analysis was probably accomplished by three or four personnel in the third and fourth week after the detonation (30).

Project 4.1, Effects of Nuclear Detonations on a Large Biological Specimen (Swine), was fielded by the Walter Reed Army Institute of Research. The project was designed to investigate, by medical experimentation, the effects of nuclear detonations on swine in an attempt to define more specifically the effects on humans. The personnel for the experiment were 179 officers and enlisted personnel from the Medical Services of the Army, Air Force, and Navy, and 13 civilians. The swine were kept in the animal holding facility along Short Pole Line Road about ten kilometers southwest of ground zero. A field hospital was located adjacent to the holding facility. Between 2300 and 0100 hours the night before the shot, an estimated 130 people placed approximately 719 swine at 11 stations located 790 meters to 2,850 meters from ground zero. Project personnel probably remained at the field hospital during the shot. About 100 project personnel, wearing protective clothing and air purification respirators, started recovery of the swine fifteen minutes after detonation and continued working, as radiation intensities permitted, until 1500 hours on shot-day, completing the recovery on 25 June (40).

Project 4.2, Evaluation of Eye Protection Afforded by an Electromechanical Shutter, was intended to assess how well an electromechanical shutter device prevented or minimized flash blindness, a temporary condition produced by the intense light of a nuclear detonation. The Air Force School of Aviation Medicine furnished examiners and rabbits for the tests, and personnel from the Navy Radiological Defense Laboratory, the Wright Patterson

Aero Medical Laboratory, and the Nellis AFB Hospital provided technical support. Two identical experimental test beds were used at Shot PRISCILLA. One was in a C-47 aircraft flown by Tactical Air Command personnel, which orbited about 25 kilometers from ground zero, and the other was in a trailer located about 18 kilometers from ground zero. Each station was equipped with a light-sensitive electromechanical shutter device with six positions for human test subjects. An examiner was present for each subject. The actual number of positions occupied varied from two to five at each station for the several PLUMBBOB shots at which this project was conducted. Examiners determined the length of time required for subjects to recover useful vision. Four or more rabbits were also exposed at each location, so that the amount of energy received could be closely correlated with the chorioretinal burn threshold in humans. The radiant energy received at the air station was greater than anticipated, but permanent retinal damage was not a problem (40).

Project 4.3, Secondary Missiles Generated by Nuclear-produced Blast Waves, was partially funded by and coordinated with AFSWP, which also furnished minor logistical support. The project was fielded by personnel of the Lovelace Foundation for Medical Education and Research under the CETG Project 33.2, Missiles Secondary to a Nuclear Blast. The project was designed to determine the size, weight, and velocity of objects such as steel fragments, glass, and gravel, that could be propelled by the blast wave from a nuclear detonation. The objects were used to impact on styrofoam targets of various densities, placed at 19 locations between 300 and 1,830 meters from ground zero. In addition, an underground shelter, constructed and tested during Operation UPSHOT-KNOTHOLE in 1953 and located 270 meters from the PRISCILLA ground zero, was also used for this project. Documentation does not indicate whether DOD personnel were involved in project activities (14).

Project 5.1, In-flight Structural Response of the HSS-1 Helicopter to a Nuclear Detonation, measured the effects of overpressure and wind gust strengths produced by a nuclear detonation on the HSS-1 helicopter. The capability of the helicopter to maneuver under these conditions was also assessed. Personnel involved in Project 5.1 were from the Navy Bureau of Aeronautics, and included one helicopter pilot, a copilot, 12 ground controllers, and aircraft maintenance personnel responsible for the special instrumentation of the helicopter. An average of four practice runs were flown prior to the mission on shot-day.

The helicopter took off 54 minutes before the detonation. During the test, doors and windows of the craft were open. After two practice passes around a holding pattern approximately eight nautical miles in length, the helicopter made the final run five minutes before the detonation, with a 90-degree turn at 40 seconds before the detonation. At shot-time, the helicopter was positioned tail-on to the blast at a slant range of 3,800 meters from ground zero. The height of the aircraft above the detonation was 4,340 feet. At the time of shock arrival, the slant range was 4,260 meters from ground zero. The helicopter landed 39 minutes after the detonation. The nuclear radiation experienced by the HSS-1 crew during the test was calculated to be below critical levels (56).

Project 5.4, In-flight Structural Response of the A4D-1 Aircraft to a Nuclear Detonation, was intended to measure the thermal and blast wave response of the A4D-1 aircraft during flight and to determine its performance and delivery capabilities during a nuclear detonation. Personnel involved in Project 5.4 were from the Navy Bureau of Aeronautics. They included the pilots, the ground controllers, and the maintenance personnel responsible for the special painting and instrumentation of the aircraft. Nuclear radiation in the aircraft was measured by four

film badges located in the bottom portion of the nose section, six film badges in the cockpit map case, and dosimeters of various ranges located in the nose-wheel door and the leg pocket of the pilot's flight suit.

Although two aircraft were planned for Shot PRISCILLA, only one participated since positioning radar was available for only one. The flight consisted of takeoff 39 minutes before the detonation, pattern entry 31 minutes prior to the shot, two practice orbits around a race-track pattern approximately 35 nautical miles in length, and a final run at 15,000 feet altitude five minutes before the shot. The test aircraft was on a straight and level course directly toward ground zero at shot-time and was positioned slightly beyond at shock arrival. The plane returned to Indian Springs AFB and landed ten minutes after the detonation (55).

Project 5.5, In-flight Structural Response of the F-89D Aircraft to a Nuclear Detonation, was to determine the structural response of the F-89D aircraft in flight to the blast and thermal effects of a nuclear detonation. Northrop Aircraft Corporation was contracted to assist the Wright Air Development Center in planning and conducting this project. Northrop Aircraft calibrated, maintained, and operated the instrumentation and its associated equipment, and correlated the data. Northrop Aircraft and Wright Air Development Center together developed positions and positioning methods. For Shot PRISCILLA, the F-89D aircraft was positioned on a heading toward ground zero at the time of shock arrival. At the time of the detonation, the F-89D was traveling about 470 knots at an altitude of 15,870 feet and a slant range of 11,235 meters from ground zero. At shock arrival, the aircraft was at an altitude of 15,820 feet and a slant range of 7,065 meters from ground zero. Negligible nuclear radiation

was predicted. No nuclear radiation was detected at the pilot and observer positions (50).

Project 6.1, Minefield Clearance by Nuclear Weapons Detonations, was sponsored by the Army Engineer Research and Development Laboratories and was fielded by eight personnel from Company A, 91st Engineer Battalion, Fort Belvoir, Virginia. The project studied the ability of a nuclear detonation to activate pressure-sensitive land mines buried at various depths and distances from ground zero. Included within the project were four subprojects conducted by or for Picatinny Arsenal, Diamond Ordnance Fuze Laboratory, U.S. Army Chemical Warfare Laboratories, and the United Kingdom. Over 1,400 inert and live mines of 15 types, both U.S. and foreign, were employed in this test. Some of the mines were placed on the surface while others were buried at depths of 8, 15, 25, 30, 45, and 90 centimeters. The eight personnel spent 30 hours before the shot surveying, digging the holes, and preparing and securing the area prior to placing the mines. It is estimated that these personnel spent 40 hours installing the mines before the shot. After the Test Director declared the test area safe for recovery operations, six men went into the test area to restore the protective fence around the mine field (9). At an unspecified time after the shot, project personnel spent 32 hours recording the data and detonating or recovering the remaining mines (23).

Project 6.2, Measurement of the Magnetic Component of the Electromagnetic Field Near a Nuclear Detonation, was designed to provide a record of the strength and characteristics of the magnetic field generated by a nuclear detonation as a function of time and distance. The project was fielded by an estimated six personnel from the Diamond Ordnance Fuze Laboratories. Instrumentation for this project consisted of five completely self-powered recording stations located at slant range distances of about 400 to 4,000 meters from ground zero.

An estimated six people spent three days installing the recording stations prior to the detonation. Approximately four hours after the detonation, three men in two vehicles retrieved instruments at one of the stations, the location of which is not specified. An estimated four people recovered the recording packages at other stations in one-half day between 29 June and 3 July (9).

Project 6.2a, Measurement of the Effects of Nuclear Radiation on Semi-conductor Devices, was designed to study the effects of neutron and gamma radiation on over 300 transistors and semiconductor diodes, including germanium and silicon types. The cans containing the transistors and diodes were packed in glass-wool insulation and placed inside heavy marine plywood boxes. The 14 plywood boxes were buried between 240 meters and 1,050 meters from ground zero and at depths between 0.15 meters and 2.8 meters, so that exposure to neutrons would vary. Documentation does not specify the number of personnel or time required to field this experiment. It is estimated that approximately two people spent two days placing the boxes in the holes, and that three people spent two days recovering the boxes between 2 July and 8 July, when radiation levels were low enough to allow personnel to work without special clothing (32).

Project 6.3, Attenuation of Electromagnetic Radiation Through an Ionized Medium, was conducted by the U.S. Naval Air Development Center with an FJ-4 aircraft. The objective was to determine the amount of electromagnetic energy that was absorbed or filtered out by the highly radioactive cloud that surrounded the area of the detonation. Electromagnetic transmitters in a pod tuned to six different frequencies were placed in an FJ-4 aircraft. Personnel included the pilot as well as receiver personnel on the ground. Other personnel included the ground controllers and aircraft maintenance personnel. The FJ-4 was

positioned so that at one minute after the detonation, the ionized cloud of the PRISCILLA device was on a straight line between the aircraft and the ground receivers (38).

Project 6.4, Accuracy and Reliability of the Short-baseline NAROL System, was designed to study the NAROL system, which is the inverse of the Long Range Aids to Navigation (LORAN) System. The experiments tested the NAROL system's ability to:

- Detect the position and measure the yield of a nuclear detonation
- Accurately detect the electromagnetic pulse from nuclear bursts
- Collect data on the propagation of the pulse as it travels over land.

The Indirect Bomb Damage Assessment NAROL system tested on this operation consisted of nets located at Albuquerque, New Mexico; Vale, Oregon; and Rapid City, South Dakota. Each NAROL net consisted of two unmanned slave stations and one manned station. The number of personnel at each manned station is not documented (36).

Project 8.1, Thermal Protection of the Individual Soldier, was intended to evaluate, under the conditions of an actual nuclear detonation, the performance of clothing and other items developed for the protection of the individual soldier. Three medical specialists from the Atomic Energy Project at the University of Rochester, Rochester, New York, and seven veterinary specialists from the Walter Reed Army Institute of Research, Washington, D.C., also participated in this project. The items developed to provide thermal protection included two experimental hot-weather uniform ensembles, three shielding materials, a protective cream, and a three-layer reflector insulating system. At Shot PRISCILLA, these items were exposed to various thermal energies, using 78 white-skinned pigs as test subjects and appropriate controls. The test was set up at five different locations

at slant ranges between 1,755 meters and 3,651 meters from ground zero.

An estimated eight personnel, accompanied by a movie photographer, began recovering the animals and filming the thermal effects about one hour after the detonation. They completed the mission in approximately one hour. All personnel who entered the radiological exclusion area were suited with protective clothing. An alternate team stood ready to take over recovery operations in case the first team had to leave the radiological exclusion area due to high radiation levels. Because gamma intensity levels measured only 0.01 R/h at the recovery stations, the first team was able to complete recovery activities safely (9; 10; 11).

Project 8.2, Prediction of Thermal Protection of Uniforms and Thermal Effects on Standard-reference Material, was designed to investigate the accuracy of laboratory experiments in predicting the effects of intense thermal radiation on live skin and tissue. Laboratory results were compared with actual skin burns in pigs exposed to thermal radiation from the nuclear detonation. Two major recording stations were instrumented with skin simulants and recording equipment at distances of 2,250 meters and 3,650 meters from ground zero. The project report does not specify how much time personnel spent in the field during recovery operations after the shot. The schedule of events indicates that eight men were scheduled to retrieve animal specimens thirty minutes after the shot and ten people were to spend one day picking up the simulant panels and equipment after the Test Director declared that recovery operations could begin (9; 26).

Project 8.3a, Performance of a High-speed Spectrographic System, tested equipment designed to analyze the electromagnetic energy from nuclear detonations. The Naval Radiological Defense Laboratory fielded this project using its high-speed spectrograph, located about 19 kilometers from ground zero in the

vicinity of the Control Point near Yucca Pass. Three or four operators were involved in fielding and recovery operations (44).

Project 8.3b, Instrumentation for Measuring Effects Phenomena Inside the Fireball, was designed to test a variety of instruments that measured the internal pressure, acceleration, velocity, and temperature of the fireball. Three groups of people from the Wright Air Development Center, University of Dayton Research Institute, and Allied Research Associates participated. The project was intended to obtain a preliminary evaluation of the time-history instrumentation system to be tested more extensively at Shot SMOKY. The specimen fielded at PRISCILLA was also designed to determine the effects of pressure and acceleration on plastic spherical shells as structural forms. Recovery operations did not begin until 3 July 1957, nine days after the shot. The radiation level at this time had dropped to approximately 0.2 R/h at ground zero. The recovery operations were terminated on 5 July. It is estimated that four personnel each spent three days in the recovery operations (21).

Project 9.1, Support Photography, provided technical photography and assistance in photographic documentation of all nuclear detonations during the PLUMBBOB Series. For technical photographic support, Project 9.1 provided camera instrumentation for Projects 1.3, 3.6, 4.1, 6.3, 8.1, and 8.2. The following estimates of personnel and time required to perform photographic support for these projects are based upon a knowledge of preshot and postshot photographic procedures.

At shot-time, Project 9.1 personnel were taking pictures from two vantage points. The first was a C-47 aircraft operated by the Military Air Transport Service. The C-47 flew a right-hand holding pattern at 10,000 feet about 16 kilometers south of the shot. The time and length of the flight are not known at this time. The second vantage point was a manned camera station located near the Control Point at Yucca Pass (26).

<u>PRESHOT PHOTOGRAPHY</u>		
<u>Project</u>	<u>Photographers per Project*</u>	<u>Days</u>
1.3	1	10
3.6	2	10
4.1	3	1
6.3	1	1
8.1	1	1
8.2	1	1

<u>POSTSHOT PHOTOGRAPHY</u>		
<u>Project</u>	<u>Photographers per Project</u>	<u>Days</u>
3.6	1	1
4.1	2	1

3.2 DEPARTMENT OF DEFENSE PARTICIPATION IN LASL AND UCRL PROJECTS AT SHOT PRISCILLA

At Shot PRISCILLA, LASL conducted 14 projects and UCRL conducted four. Of these, only LASL Project 11.2, Radiochemistry Sampling, and UCRL Project 21.2, Radiochemistry Sampling, required DOD participation. As shown in table 3-2, both of these

Table 3-2: LASL, UCRL, AND CETG PROJECTS WITH DOD PERSONNEL INVOLVEMENT, SHOT PRISCILLA

Project	Title	Sponsor	Estimated Number DOD Personnel	DOD Agency	Capacity
11.2 21.2	Radiochemistry Sampling	LASL UCRL	10	4926th Test Squadron, AFSWC	Cloud Sampling
33.2	Missiles Secondary to a Nuclear Blast	CETG	*	Armed Forces Special Weapons Project 43 Personnel	Logistics
37.2/ 37.2a	Biophysical and Physical Aspects of Fallout	CETG	1	AFSWC	Radio Relay

* Unknown

*Some photographers participated in more than one project.

projects were performed by the same sampler pilots and aircraft from the AFSWC 4926th Test Squadron (Sampling). DOD involvement was limited to these AFSWC personnel. Consequently, these projects are discussed in section 3.5 of this chapter.

3.3 DEPARTMENT OF DEFENSE PARTICIPATION IN CIVIL EFFECTS TEST GROUP PROJECTS AT SHOT PRISCILLA

Of the 30 projects conducted by the Federal Civil Defense Administration Civil Effects Test Group (CETG) at Shot PRISCILLA, DOD personnel took part in only two, as indicated in table 3-2.

Project 33.2, Missiles Secondary to a Nuclear Blast, was managed by the Civil Effects Test Group. The project was partially funded and coordinated by the Department of Defense as the Weapons Effects Test Group Project 4.3, Secondary Missiles Generated by Nuclear-produced Blast Waves. In addition to funding and coordination, the Weapons Effects Test Group furnished minor logistical support. DOD personnel probably did not take part in project procedures in the forward area (14).

Project 37.2/37.2a, Biophysical and Physical Aspects of Fallout, was assisted by one C-47 aircraft, provided by AFSWC. Since DOD participation in this project was performed by AFSWC, Project 37.2/37.2a is discussed in section 3.5.

3.4 DEPARTMENT OF DEFENSE OPERATIONAL TRAINING PROJECTS AT SHOT PRISCILLA

The primary objectives of the operational training projects were to test service tactics and operational equipment and to train and indoctrinate Air Force personnel in the effects of nuclear detonations. The Air Force conducted three operational training projects at Shot PRISCILLA, as listed in table 3-3.

Table 3-3: DOD OPERATIONAL TRAINING PROJECTS, SHOT PRISCILLA

Project	Title	Sponsor	Type Aircraft	No. Aircraft	Staging Base	No. Personnel
53.5	Aircrew Indoctrination (Early Cloud Penetration)	Air Defense Command	T-33	2	Indian Springs	4
53.7	Indirect Bomb Damage Assessment	Wright Air Command Development	F-89D	1	Indian Springs AFB, Nevada	1
53.9	Photographic Reconnaissance Training	Tactical Air Command	RF-84F	2	Georgen AFB, California	2

Project 53.5, Aircrew Indoctrination (Early Cloud Penetration), was designed to enable Air Defense Command aircrews and commanders to witness a nuclear detonation and penetrate its cloud. Only two of the six scheduled flights of T-33 aircraft participated at Shot PRISCILLA. The aircraft, each with a crew of two, departed from Indian Springs AFB at an unspecified time. At approximately 0900 hours on shot-day, the T-33 aircraft flew a four-minute left-hand elliptical course inbound at 34,000 feet, orbiting a point that was 38 nautical miles north of ground zero. The aircraft were flown by Air National Guard personnel from either the 139th Fighter Interceptor Squadron of Schenectady, New York, or the 170th Fighter Interceptor Squadron of Springfield, Illinois.

Project 53.7, Indirect Bomb Damage Assessment, required personnel from the Wright Air Development Center to install Indirect Bomb Damage Assessment equipment aboard an F-89D aircraft. At shot-time, the pilot flew a right-hand 40-nautical mile race-track pattern abeam of ground zero at 35,000 feet and 70 nautical miles east of ground zero. The F-89D returned to Indian Springs AFB for decontamination.

Project 53.9, Photographic Reconnaissance Training, indoctrinated Air National Guard Tactical Reconnaissance units in conducting photographic missions over a nuclear target. For Shot PRISCILLA, two RF-84F aircraft, each manned by one pilot, departed from George AFB, California. The aircraft flew to the NTS, where they orbited above Lathrop Wells at 31,000 feet until the shot was detonated. Upon clearance from the Air Operations Center, they began a photographic mission toward ground zero. They crossed the shot area approximately 15 minutes after the detonation at an altitude of 10,000 feet. Upon completion of the run, they returned to George AFB (26).

3.5 AIR FORCE SPECIAL WEAPONS CENTER ACTIVITIES AT SHOT PRISCILLA

Air Force Special Weapons Center support during PRISCILLA was provided by the 4950th Test Group (Nuclear), including the 4926th Test Squadron (Sampling) and the 4935th Air Base Squadron, with support from the 4900th Air Base Group. AFSWC support was provided to test group projects and to the Test Manager for Shot PRISCILLA. AFSWC maintained the Air Operations Center at the Control Point, and exercised operational control of aircraft flying in the vicinity of the NTS at shot-time. AFSWC support consisted of nuclear cloud-sampling and sample return missions for LASL Project 11.2 and UCRL Project 21.2, a radio-relay for CETG Project 37.2/37.2a, cloud-tracking missions, aircraft contamination studies, security sweeps, and aerial surveys. Table 3-4 indicates DOD participation in AFSWC projects, including the numbers and types of aircraft used.

Table 3-4: AFSWC AIR MISSION SUPPORT, SHOT PRISCILLA

Program/Project	Mission	Type Aircraft	Number of Aircraft	Estimated DOD Personnel
11.2 21.2	Cloud Sampling			
	Sampler Control	B-57	1	2
	Sampler	B-57	3	6
	Sampler	F-84	2	2
	Sample Return	C-47	4	*
37.2 37.2a	Radio-relay	C-47	1	*
—————	Cloud Tracking	B-50	1	8
		B-29	1	9
		B-25	2	*
—————	Aircraft Contamination	T-33	1	2
—————	Security Sweep	L-20	2	4
—————	Survey Mission	H-21	4	8

* Unknown

3.5.1 Cloud Sampling

At PRISCILLA, five aircraft collected samples of the nuclear cloud for LASL Project 11.2, Radiochemistry Sampling, and UCRL Project 21.2, Radiochemistry Sampling. These five sampler aircraft were flown by pilots of the 4926th Test Squadron (Sampling) and included three B-57Bs, each with two crewmen, and two F-84Gs, with one pilot each. A B-57B sampler control aircraft, with an AFSWC pilot accompanied by a scientific advisor from LASL, also participated.

The sampler control aircraft left Indian Springs AFB at 0520 hours, and was positioned outside the test area before shot-time. At 0525 hours, the sampler control aircraft reached an altitude of 35,000 feet and, at 0535 hours, began an orbital pattern.

The five sampler aircraft proceeded as follows. Two B-57Bs, with two crewmen each, flew from Indian Springs AFB at 0650 hours. These sampler aircraft entered the vicinity of the

detonation at 0655 hours and established visual contact with the sampler control aircraft, which guided them to areas for obtaining samples of the nuclear cloud. The two B-57B sampler aircraft finished their orbital patterns at 0725 hours, left the area at 0730 hours, and landed at Indian Springs AFB at 0735 hours.

At 0705 hours, 15 minutes after the first two B-57B sampler aircraft took off from Indian Springs AFB, the two F-84G aircraft, manned by one pilot each, left Indian Springs AFB. These aircraft entered the sampling area at 0710 hours, completed their sampling run at 0740 hours, left the area at 0745 hours, and landed at Indian Springs AFB at 0750 hours.

The fifth and final sampler was a B-57B operated by two crewmen. This aircraft flew from Indian Springs AFB at 0735 hours, entered the sampling area at 0740 hours, completed its mission at 0810 hours and, followed by the B-57B sampler control aircraft, landed at Indian Springs AFB at 0820 hours.

Upon landing, sampler aircraft taxied to the strip farthest from base operations. There, ground personnel removed the samples and placed them in metal containers which were sent by courier to the laboratories. Following this, aircraft, pilot, and crew went through the routine decontamination procedures described in chapter 3 of the PLUMBBOB Series volume.

The courier sample returns were conducted by the 4900th Air Base Group from Kirtland AFB. Three C-47 aircraft, carrying at least three crewmen each, flew samples out of Indian Springs AFB to the LASL and UCRL laboratories for analysis (2).

3.5.2 Radio Relay

AFSWC support for Project 37.2/37.2a, Biophysical and Physical Aspects of Fallout, was provided by one C-47 aircraft

with an unspecified number of people on board. The C-47 performed a radio relay for this project, flying a right-hand elliptical pattern 20 nautical miles southeast of ground zero. The time the aircraft remained aloft is unknown (2).

3.5.3 Cloud Tracking

Immediately after the PRISCILLA detonation, four aircraft, a B-50, a B-29, and two B-25s, flew cloud-tracking missions over and beyond the NTS for the Test Manager. The B-50 aircraft, with a minimum of eight crew members, departed from Kirtland AFB and flew a right-hand elliptical pattern 20 nautical miles from ground zero at an altitude of 25,000 feet. The B-29, with six to nine crew members, departed from Indian Springs AFB and flew at 20,000 feet. Available documentation does not specify the flight pattern and the distance from ground zero for these missions. The two B-25s flew at altitudes of 15,000 feet. Documentation does not indicate the number of crew members, flight pattern, and distance from ground zero for the B-25s on this mission (2).

3.5.4 Aircraft Contamination

Beginning with Shot PRISCILLA, AFSWC introduced a study to determine whether or not the Air Force needed to monitor the accumulation of radioactive contaminants on aircraft. A T-33, piloted by an officer from the 4926th Test Squadron and carrying an observer, penetrated the PRISCILLA nuclear cloud and those of the four subsequent PLUMBBOB nuclear events. The pilot and the observer both wore lead vests instrumented with film badges, and six additional film badges were taped to the ejection seats. Upon returning to Indian Springs AFB, the plane was not decontaminated, but a 24-hour period was permitted for radiation decay before maintenance was performed. In addition to the T-33 not being decontaminated, the pilot and observer boarded and departed

from the aircraft using standard ladders, not the forklift procedures used in other AFSWC missions. However, the pilot and observer were both closely monitored and decontaminated following each flight. The aircraft was finally decontaminated after the OWENS shot on 25 July (1).

3.5.5 Security Sweep Mission

The evening before shot-day, two L-20 aircraft were dispatched from Yucca airstrip to perform a security sweep mission over the NTS area in general and over the Frenchman Flat test area in particular. The security sweep called for a security guard to accompany the pilot on the mission. The time aloft, the flight configuration, and the time of return to base are not documented. The L-20 aircraft were used for onsite pre- and postshot sweeps. The postshot sweeps were generally conducted immediately after the detonation and remained aloft for one hour (2).

3.5.6 Survey Missions

Four H-21 helicopters were scheduled to fly survey missions over the Frenchman Flat area to assess and record detonation damage and record radiation intensities. Information from this project would also support Project 50.8. The four H-21 helicopters each had two AFSWC crew members aboard, as well as two radiation-safety monitors from Reynolds Engineering and Electrical Company. Following the mission, helicopters were scheduled to return to the launch pad for monitoring and decontamination as required (2). Research indicates that following the detonation, these helicopters were unable to undertake their missions until the day after Shot PRISCILLA (2).

CHAPTER 4

RADIATION PROTECTION AT SHOT PRISCILLA

To protect participants at Shot PRISCILLA from the radiation associated with the detonation of a nuclear device, Exercise Desert Rock VII and VIII, the Nevada Test Organization (NTO), and the Air Force Special Weapons Center (AFSWC) each used accepted standards to develop its own criteria and procedures to ensure the radiological safety of its members. These safety criteria and procedures, as well as the organizations developed to implement the procedures, are detailed in chapter 3 of the PLUMBBOB Series volume.

The purpose of the radiation protection procedures developed for the PLUMBBOB Series was to minimize individual exposure to ionizing radiation. At the same time, the procedures were designed so that participants could accomplish the operational requirements of each activity or mission. Some of the radiological safety procedures described in the Series volume required Exercise Desert Rock, NTO, and AFSWC to keep records. These records can be used to evaluate the effectiveness of their radiation protection programs.

Records have not been found for every radiation protection procedure used at Shot PRISCILLA, however. The information that is available includes film badge readings for all participants in Exercise Desert Rock except some of the Marines, NTO dosimetry data, logistical data on radiological safety equipment issued, survey records and isointensity plots, and decontamination records.

4.1 FILM BADGE DATA FOR PARTICIPANTS IN THE TROOP OBSERVER INDOCTRINATION PROGRAM AT SHOT PRISCILLA

Each Exercise Desert Rock VII and VIII participant was issued a film badge. Form LSD SCTF 10, the Lexington Signal Depot Film Badge Service Radiation Report form, was used to record the individual's name, rank, serial number, organization, film badge number, and exposure. While the forms include much useful information, they did not always provide information specific to Shot PRISCILLA. A number of recordkeeping problems existed that hindered planned procedures for processing film badges. Information on these forms was not always recorded accurately, e.g., names were misspelled and incorrect organization names were recorded. Furthermore, LSD SCTF 10 forms list periods of exposure which vary from two days to two months and which often overlapped with other shot dates.

Although film badge data are available for all Desert Rock activities, the Desert Rock activity with the largest DOD participation at Shot PRISCILLA was the troop observer indoctrination program. This program was conducted throughout the PLUMBBOB Series, occasionally hindering shot-specific identification of film badge readings. Shot specific participation at PRISCILLA was obtained, however, by examining the available LSD SCTF 10 exposure reports for the period 19 June to 4 July 1957. Exposure reports in which the time period extended beyond 4 July are not included in the PRISCILLA discussion. Examination of the LSD SCTF 10 forms positively identified 240 personnel who participated in the observer program at PRISCILLA. These records indicate that the average gamma exposure was about 0.4 roentgens with a range of 0.16 to 0.65 roentgens.

The available dosimetry data does not account for all the observers listed in the Exercise Desert Rock VII and VIII Final

Report (33). This report indicates that observers at Shot PRISCILLA included the following representations:

Army	540
Navy	5
Marine Corps	349
Air Force	<u>17</u>
	911

The observers witnessed Shot PRISCILLA from two locations. A total of 311 Marines from the 4th Marine Corps Provisional Atomic Exercise Brigade observed the shot from trenches located between 3900 and 4000 meters southwest of ground zero. About two hours after the shot, these observers moved forward in trucks to the equipment display area and remained there for two hours before returning to Camp Desert Rock. The remaining observers witnessed PRISCILLA from a distance of 11 kilometers and did not visit the display area (45).

As indicated above, exposure records account for 240 of these observers. The remaining exposure records are not specific enough to identify the other 661 individuals reported as Desert Rock observers at Shot PRISCILLA.

The second largest Desert Rock activity at PRISCILLA was Project 50.8, Detection of Atomic Burst and Radioactive Fallout. A total of 556 Desert Rock personnel were assigned to the project to test nuclear detection equipment and fallout prediction procedures (33). The participating services for this project are listed in table 2-1, chapter 2.

As with the troop observer program, Project 50.8 was conducted throughout Operation PLUMBBOB, impeding the identification of shot-specific film badge data. However, examination of available PLUMBBOB LSD SCTF 10 exposure forms revealed 83 Project 50.8 personnel that had film badge data for the dates 18 June through 25 June. This time period covers Shots

WILSON (18 June) and PRISCILLA (24 June). Information providing further shot-specificity is not available. The 83 identified personnel had an average gamma exposure of 0.5 roentgens, with a range of 0.0 to 2.68 roentgens. Only two individuals received exposures exceeding 2.0 roentgens.

4.2 RESULTS OF THE NEVADA TEST ORGANIZATION RADIATION PROTECTION ACTIVITIES

The following subsections indicate specific data concerning radiological protection activities performed by the Nevada Test Organization at Shot PRISCILLA.

Dosimetry Records for PRISCILLA

From 24 June to 3 July 1957, which covers the 24 June detonation of PRISCILLA, the Personnel Dosimetry Branch of the NTO issued 6,604 film badges and 851 pocket dosimeters (57). Dosimetry data indicate that three DOD participants received gamma exposures exceeding the recommended limit of 3.0 roentgens per 13-week period. These participants, however, were cloud sampling pilots from the 4950th Test Group (Nuclear) who had been authorized to receive a maximum of 7.5 roentgens of gamma exposure. None exceeded this upper limit; the exposures were 3.5, 3.9, and 7.0 roentgens (33).

Although the number of AFSWC participants who wore film badges is not known, data have been found which indicate the exposures that ground crews received during aircraft decontamination. For the decontamination of F-84 cloud sampler aircraft at Shots PRISCILLA, HOOD, DIABLO, DOPPLER, and OWENS, ground crew members received an average exposure across all five shots of 0.112 roentgens. No shot-specific exposure data are available (1).

Logistical Information for Radiological Safety Equipment

For Shot PRISCILLA, the Logistics Branch issued 1,464 pieces of protective clothing and 370 respirators. A total of 335 sets of prepackaged clothing for entry into radiation areas was issued to DOD personnel for the PRISCILLA event (45; 57).

Monitoring Procedures and Support at PRISCILLA

The initial survey party, consisting of 15 monitors in ten vehicles, began the initial survey of the shot area after a delay because of severe dust conditions. The survey was performed with a mid-time of 0809 hours, about 90 minutes after the detonation. After surveying Frenchman Flat, monitoring teams also conducted ground surveys of other areas of the NTS. They found no increase in radiation intensities in the other areas as a result of the shot. Frenchman Flat was resurveyed at a mid-time of 1308 hours on shot-day, and again on 25, 26, 27, 28, and 29 June and on 1 July.

Because of the severe dust conditions which followed Shot PRISCILLA, the aerial survey team, consisting of two AFSWC crewmen and two REECO monitors in an H-21 helicopter, could not begin their survey until over six hours after the detonation. The survey was attempted at 1119 hours, but heavy dust still obscured the ground points necessary to conduct the survey. At 1305 hours, the team was able to begin its survey. This survey followed a predetermined course along an arc southwest to northwest of ground zero at a distance of 670 meters from the shot. The aerial team also resurveyed the area around the PRISCILLA ground zero on 25 and 26 June. The maximum intensity that the aerial survey team encountered was 100 R/h 500 feet above ground zero at 0915 hours on 25 June (45; 57).

Plotting and Briefing at PRISCILLA

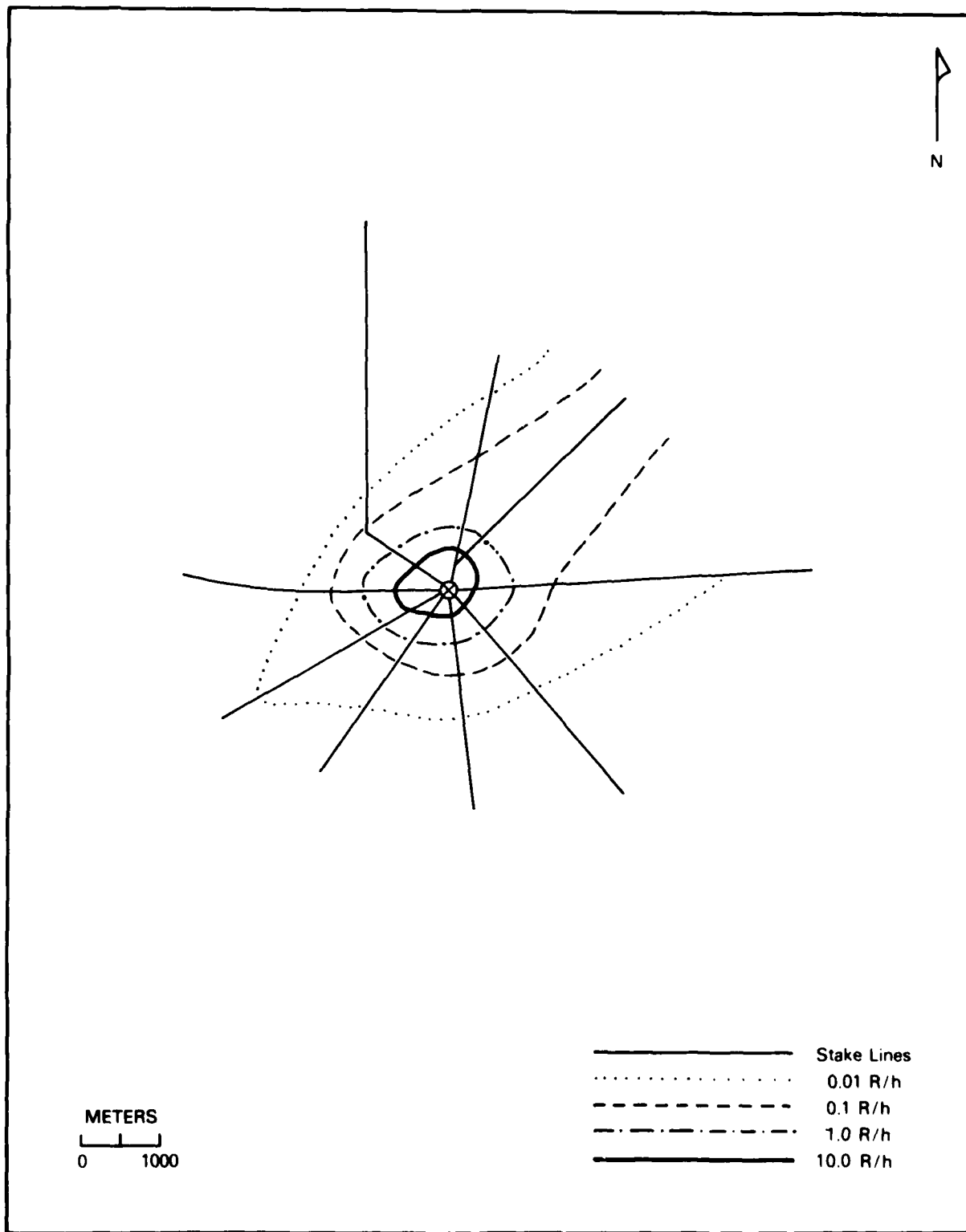
Using information from the initial surveys, the Plotting and Briefing Branch developed isointensity contour maps. Figure 4-1 shows a copy of the initial contour map, with radiation intensities at a mid-time of 0809 hours. Figures 4-2 through 4-5 show copies of isointensity contour maps generated from resurveys conducted from 24 June through 27 June (57).

Information from the ground surveys allowed the Plotting and Briefing Branch to establish 0.1 R/h and 0.01 R/h radiation areas. The Plotting and Briefing Branch also issued the access permits required for entry into these areas. During the period 24 June through 4 July, access permits were issued to a total of 1,582 individuals (45; 57).

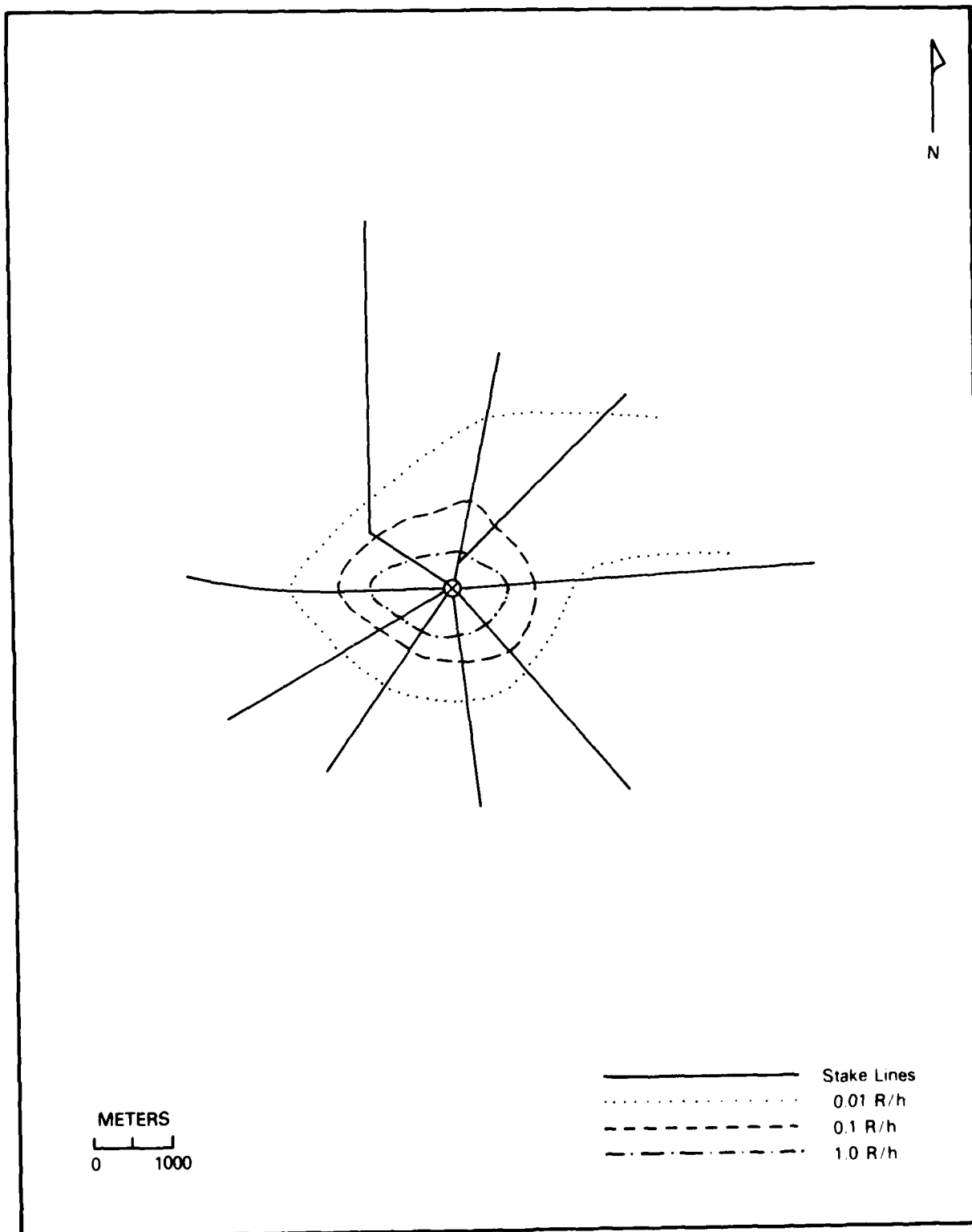
Decontamination Activities at PRISCILLA

During the period covering Shot PRISCILLA, 24 June through 4 July, personnel of the Decontamination Branch decontaminated 138 vehicles and 86 instruments at Control Point Building 6 (57). In addition, 40 vehicles were processed through the Frenchman Flat Auxiliary Field Decontamination Facility after Shot PRISCILLA (45; 57).

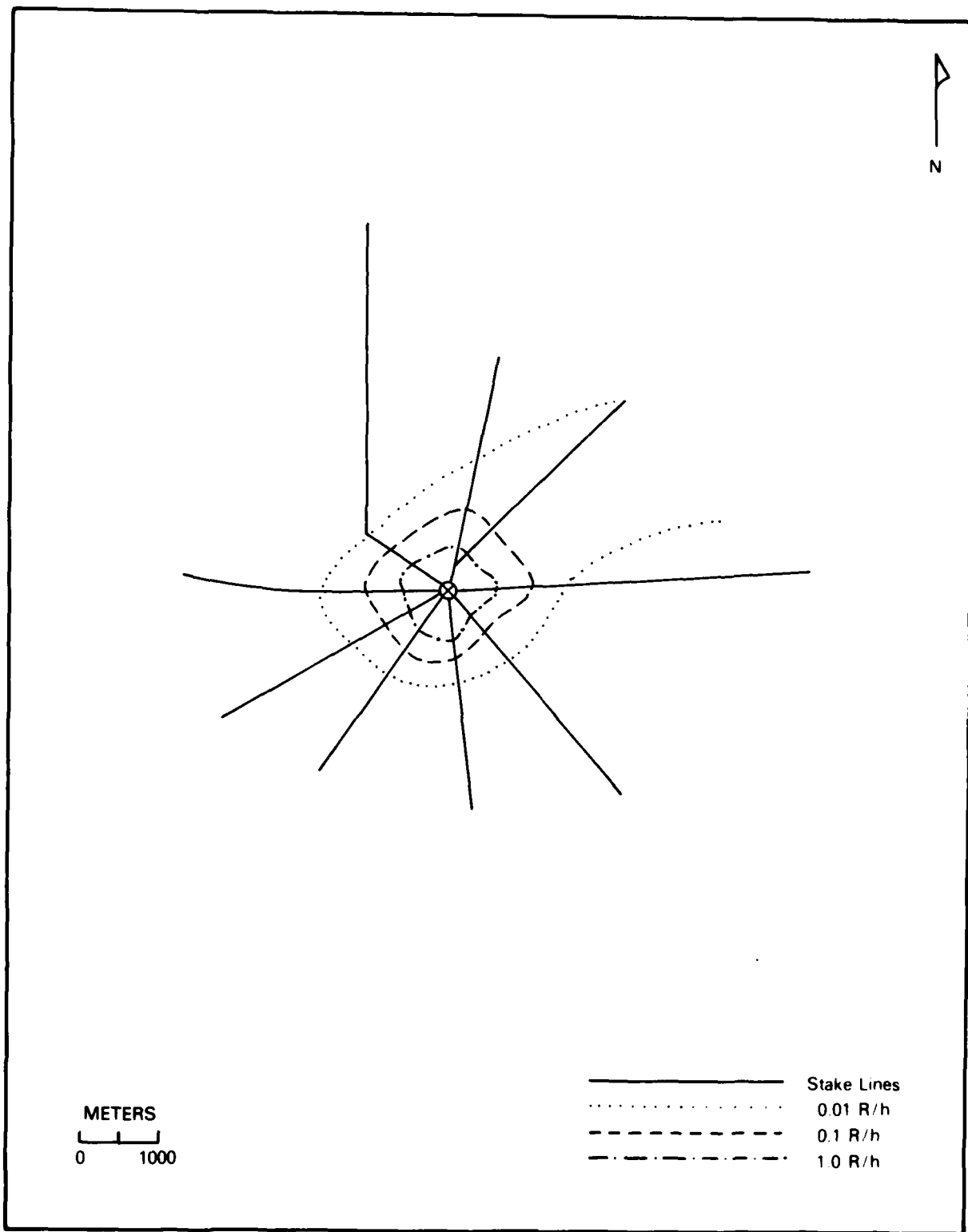
This concludes the presentation of results generated by the radiation protection activities of the NTO onsite radiological safety group. No indication of AFSWC shot-specific radiological safety activities has been located. Activities that are standard for the entire series, however, are discussed in the PLUMBBOB Series volume.



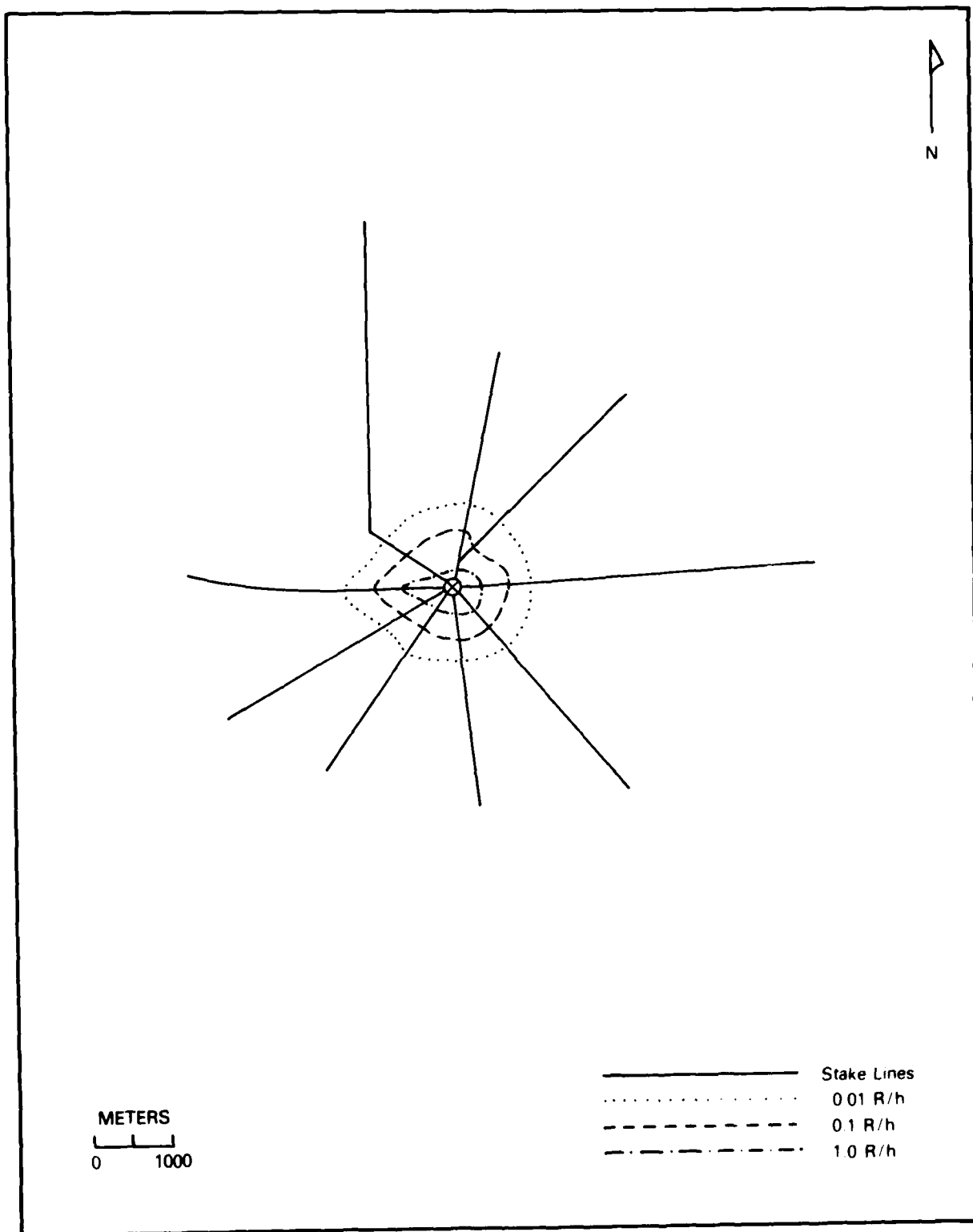
**Figure 4-1: INITIAL SURVEY FOR SHOT PRISCILLA,
24 JUNE 1967, MID-TIME 0809**



**Figure 4-2: RESURVEY FOR SHOT PRISCILLA,
24 JUNE 1957, MID-TIME 1308**



**Figure 4-3: RESURVEY FOR SHOT PRISCILLA,
25 JUNE 1967, MID-TIME 0658**



**Figure 4-4: RESURVEY FOR SHOT PRISCILLA,
26 JUNE 1967, MID-TIME 0550**

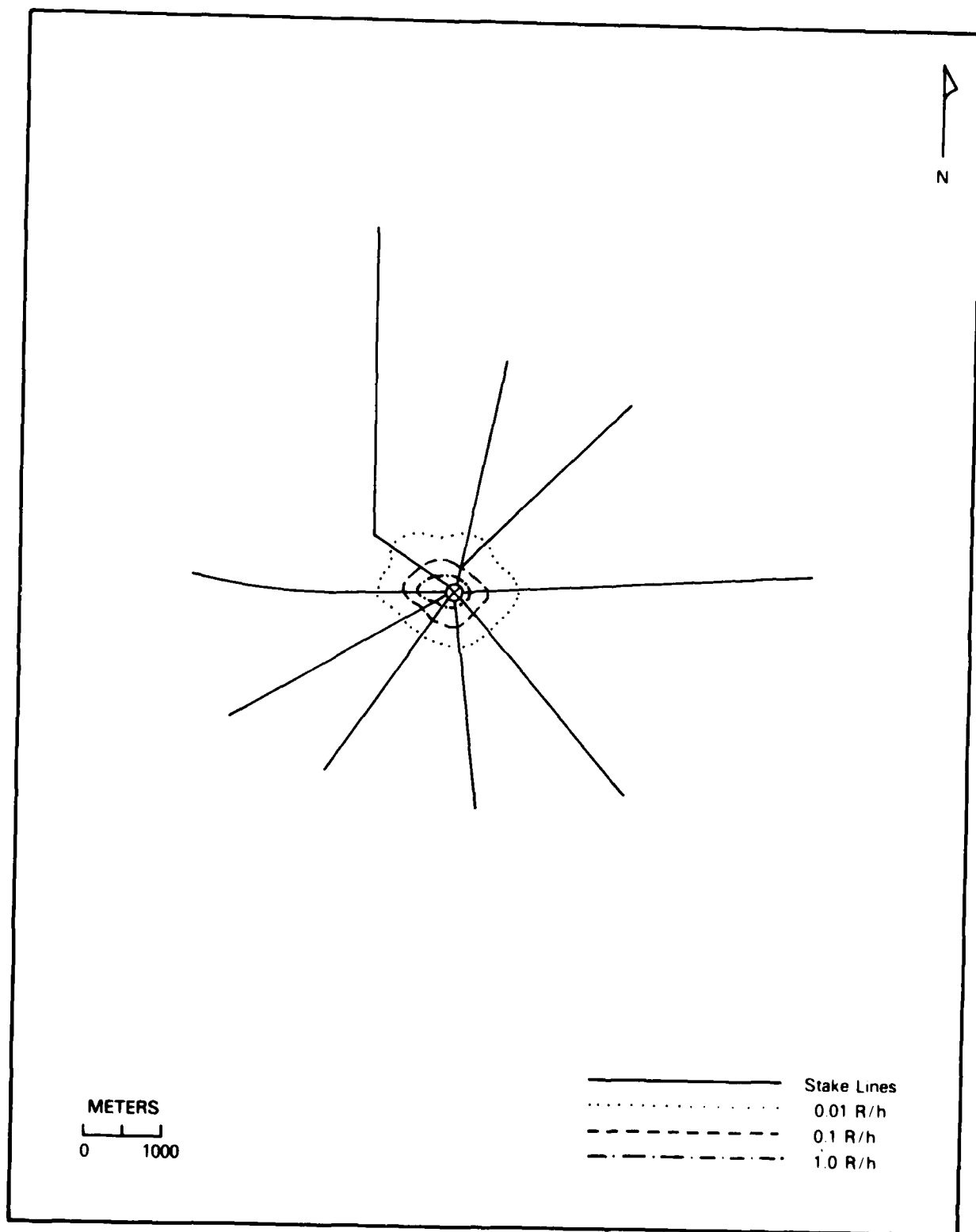


Figure 4-5: RESURVEY FOR SHOT PRISCILLA,
27 JUNE 1967, MID-TIME 0548

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ATTN: Director

Veterans Administration-RO
Montgomery, AL
ATTN: Director

Veterans Administration-RO
Juneau, AK
ATTN: Director

Veterans Administration-RO
Anchorage, AK
ATTN: Director

Veterans Administration-RO
Phoenix, AZ
ATTN: Director

Veterans Administration-RO
Little Rock, AR
ATTN: Director

Veterans Administration-RO
Los Angeles, CA
ATTN: Director

Veterans Administration-RO
San Francisco, CA
ATTN: Director

Veterans Administration-RO
Denver, CO
ATTN: Director

Veterans Administration-RO
Hartford, CT
ATTN: Director

Veterans Administration-RO
Wilmington, DE
ATTN: Director

Veterans Administration-RO
Washington, D. C.
ATTN: Dep. Veterans Benefit, Central Ofc
ATTN: Director
ATTN: Board of Veteran Appeal

Veterans Administration-RO
St. Petersburg, FL
ATTN: Director

OTHER GOVERNMENT AGENCIES (Continued)

Veterans Administration-RO
Atlanta, GA
ATTN: Director

Veterans Administration-RO
Honolulu, HI
ATTN: Director

Veterans Administration-RO
Chicago, IL
ATTN: Director

Veterans Administration-RO
Seattle, WA
ATTN: Director

Veterans Administration-RO
Indianapolis, IN
ATTN: Director

Veterans Administration-RO
Des Moines, IA
ATTN: Director

Veterans Administration-RO
Wichita, KS
ATTN: Director

Veterans Administration-RO
Louisville, KY
ATTN: Director

Veterans Administration-RO
New Orleans, LA
ATTN: Director

Veterans Administration-RO
Togus, ME
ATTN: Director

Veterans Administration-RO
Baltimore, MD
ATTN: Director

Veterans Administration-RO
Boston, MA
ATTN: Director

Veterans Administration-RO
St. Paul, MN
ATTN: Director

Veterans Administration-RO
Jackson, MS
ATTN: Director

Veterans Administration-RO
Huntington, WV
ATTN: Director

Veterans Administration-RO
St. Louis, MO
ATTN: Director

Veterans Administration-RO
Ft. Harrison, MT
ATTN: Director

OTHER GOVERNMENT AGENCIES (Continued)

Veterans Administration-RO
Lincoln, NE
ATTN: Director

Veterans Administration-RO
Reno, NV
ATTN: Director

Veterans Administration-RO
Manchester, NH
ATTN: Director

Veterans Administration-RO
Newark, NJ
ATTN: Director

Veterans Administration-RO
Milwaukee, WI
ATTN: Director

Veterans Administration-RO
Albuquerque, NM
ATTN: Director

Veterans Administration-RO
Buffalo, NY
ATTN: Director

Veterans Administration-RO
New York, NY
ATTN: Director

Veterans Administration-RO
Winston-Salem, NC
ATTN: Director

Veterans Administration-RO
Fargo, ND
ATTN: Director

Veterans Administration-RO
Cleveland, OH
ATTN: Director

Veterans Administration-RO
Muskogee, OK
ATTN: Director

Veterans Administration-RO
Portland, OR
ATTN: Director

Veterans Administration-RO
Pittsburgh, PA
ATTN: Director

Veterans Administration-RO
Philadelphia, PA
ATTN: Director

Veterans Administration-RO
San Francisco, CA
ATTN: Director

Veterans Administration-RO
San Juan, Puerto Rico
ATTN: Director

OTHER GOVERNMENT AGENCIES (Continued)

Veterans Administration-RO
Columbia, SC
ATTN: Director

Veterans Administration-RO
Sioux Falls, SD
ATTN: Director

Veterans Administration-RO
Houston, TX
ATTN: Director

Veterans Administration-RO
Waco, TX
ATTN: Director

Veterans Administration-RO
Salt Lake City, UT
ATTN: Director

Veterans Administration-RO
White River Junction, VT
ATTN: Director

Veterans Administration-RO
Roanoke, VA
ATTN: Director

Veterans Administration-RO
Cheyenne, WY
ATTN: Director

Veterans Administration-RO
San Diego, CA
ATTN: Director

Veterans Administration-RO
Boise, ID
ATTN: Director

Veterans Administration-RO
Detroit, MI
ATTN: Director

Veterans Administration-RO
Nashville, TN
ATTN: Director

The White House
ATTN: Domestic Policy Staff

DEPARTMENT OF ENERGY CONTRACTORS

Lawrence Livermore National Lab
ATTN: Tech Info Dept Library

Los Alamos National Scientific Lab
ATTN: Library
ATTN: MS 195

Sandia National Lab
ATTN: W. Hereford
ATTN: Central Library

Reynolds Electrical & Engr Co., Inc
ATTN: CIC
ATTN: W. Brady

OTHER

Adams State College
ATTN: Librn

Akron Public Library
ATTN: Librn

Alabama State Dept of Archives & History
ATTN: Military Records Div

University of Alabama
ATTN: Reference Dept, Dralier 3
ATTN: Director of Libraries (Reg)

University of Alaska Library at Anchorage
ATTN: Dir of Libraries

University of Alaska
ATTN: Librn

Albany Public Library
ATTN: Librn

Alexander City State Jr College
ATTN: Librn

Allegheny College
ATTN: Librn

Allen County Public Library
ATTN: Librn

Altoona Area Public Library
ATTN: Librn

American Statistics Index
Congressional Info Service, Inc
ATTN: Cathy Jarvey

Anaheim Public Library
ATTN: Librn

College of Wooster
ATTN: Gov Docs

Angelo State University Library
ATTN: Librn

Angelo Icoboni Public Library
ATTN: Librn

Anoka County Library
ATTN: Librn

Appalachian State University
ATTN: Library Docs

Arizona State University Library
ATTN: Librn

University of Arizona
ATTN: Dir of Libraries (Reg)

Arkansas College Library
ATTN: Library

Brooklyn College
ATTN: Doc Div

OTHER (Continued)

Arkansas Library Comm
ATTN: Library

Arkansas State University
ATTN: Library

University of Arkansas
ATTN: Gov Docs Div

Austin College
ATTN: Librn

Atlanta Public Library
ATTN: Ivan Allen Dept

Atlanta University
ATTN: Librn

Auburn University Library at Montgomery (Reg)
ATTN: Librn

C. W. Post Ctr Long Island University
ATTN: Librn

Bangor Public Library
ATTN: Librn

Bates College Library
ATTN: Librn

Baylor University Library
ATTN: Docs Dept

Beloit College Libraries
ATTN: Serials Docs Dept

Bemidji State College
ATTN: Library

State University College
ATTN: Gov Docs

Akron University
ATTN: Gov Docs

Boston Public Library (Reg)
ATTN: Docs Dept

Bowdoin College
ATTN: Librn

Bowling Green State University
ATTN: Lib Gov Docs Services

Bradley University
ATTN: Librn

Brandeis University Library
ATTN: Docs Section

Brigham Young University
ATTN: Librn

Brigham Young University
ATTN: Docs Collection

Brookhaven National Laboratory
ATTN: Tech Library

OTHER (Continued)

Broward County Library Sys
ATTN: Librn

Brown University
ATTN: Librn

Bucknell University
ATTN: Reference Dept

Buffalo & Erie Co Public Library
ATTN: Librn

State University Library of California at Fresno
ATTN: Library

University Library of California at Los Angeles
ATTN: Pub Affairs Serv U.S. Docs

University of California at San Diego
ATTN: Docs Dept

State College Library of California at Stanislaus
ATTN: Library

California State Polytechnic University Library
ATTN: Librn

California State University at Northridge
ATTN: Gov Doc

California State Library (Reg)
ATTN: Librn

California State University at Long Beach Library
ATTN: Librn

California State University
ATTN: Librn

California State University
ATTN: Librn

California University Library
ATTN: Gov Pub Dept

California University Library
ATTN: Librn

California University Library
ATTN: Gov Docs Dept

California University Library
ATTN: Docs Sec

University of California
ATTN: Gov Docs Dept

Calvin College Library
ATTN: Librn

Kearney State College
ATTN: Gov Docs Dept

Cambria County Library Sys
ATTN: Librn

Carleton College Library
ATTN: Librn

OTHER (Continued)

Carnegie Library of Pittsburgh
ATTN: Librn

Carnegie Mellon University
ATTN: Dir of Libraries

Carson Regional Library
ATTN: Gov Pubs Unit

Case Western Reserve University
ATTN: Librn

Casper College
ATTN: Librn

University of Central Florida
ATTN: Library Docs Dept

Central Michigan University
ATTN: Library Docs Sec

Central Montana State College
ATTN: Gov Docs

Central State University
ATTN: Lib Docs Dept

Central Washington University
ATTN: Lib Docs Sec

Central Wyoming College Library
ATTN: Librn

Charleston County Library
ATTN: Librn

Charlotte & Mecklenburg County Public Library
ATTN: E. Correll

Chattanooga Hamilton County, Bicentennial Library
ATTN: Librn

Chesapeake Public Library System
ATTN: Librn

Chicago Public Library
ATTN: Gov Pubs Dept

State University of Chicago
ATTN: Librn

Chicago University Library
ATTN: Dir of Libraries
ATTN: Docs Processing

Cincinnati University Library
ATTN: Librn

Citadel, Daniel Library
ATTN: Librn

Claremont Colleges Libraries
ATTN: Doc Collection

Clemson University
ATTN: Dir of Libraries

OTHER (Continued)

Cleveland Public Library
ATTN: Docs Collection

Cleveland State University Library
ATTN: Librn

Coe Library
ATTN: Docs Div

Colgate University Library
ATTN: Ref Lib

Colorado State University Libraries
ATTN: Librn

University of Colorado Libraries
ATTN: Dir of Libraries

Columbia University Library
ATTN: Docs Svc Ctr

Columbus & Franklin Cty Public Library
ATTN: Gen Rec Div

Compton Library
ATTN: Librn

Connecticut State Library (Reg)
ATTN: Librn

University of Connecticut
ATTN: Gov't of Connecticut

University of Connecticut
ATTN: Dir of Libraries

Cornell University Library
ATTN: Librn

Corpus Christi State University Library
ATTN: Librn

Culver City Library
ATTN: Librn

Curry College Library
ATTN: Librn

University of North Carolina at Asheville
ATTN: Librn

Dallas County Public Library
ATTN: Librn

Dallas Public Library
ATTN: Librn

Dalton Junior College Library
ATTN: Librn

Dartmouth College
ATTN: Librn

Davenport Public Library
ATTN: Librn

Davidson College
ATTN: Librn

OTHER (Continued)

Dayton & Montgomery City Public Library
ATTN: Librn

University of Dayton
ATTN: Librn

Decatur Public Library
ATTN: Librn

Dekalb Community College SO CPUS
ATTN: Librn

Delaware Pauw University
ATTN: Librn

University of Delaware
ATTN: Librn

Delta College Library
ATTN: Librn

Delta State University
ATTN: Librn

Denison University Library
ATTN: Librn

Denver Public Library (Reg)
ATTN: Docs Div

Dept of Library & Archives (Reg)
ATTN: Librn

Detroit Public Library
ATTN: Librn

Dickinson College Library
ATTN: Librn

Dickinson State College
ATTN: Librn

Alabama Agricultural Mechanical University & Coll
ATTN: Librn

Drake University
ATTN: Cowles Library

Drew University
ATTN: Librn

Duke University
ATTN: Pub Docs Dept

Duluth Public Library
ATTN: Docs Sec

East Carolina University
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East Central University
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East Islip Public Library
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OTHER (Continued)

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East Tennessee State University Sherrod Library
ATTN: Docs Dept

East Texas State University
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Monmouth County Library Eastern Branch
ATTN: Librn

Eastern Illinois University
ATTN: Librn

Eastern Kentucky University
ATTN: Librn

Eastern Michigan University Library
ATTN: Library

Eastern Montana College Library
ATTN: Docs Dept

Eastern New Mexico University
ATTN: Librn

Eastern Oregon College Library
ATTN: Librn

Eastern Washington University
ATTN: Librn

El Paso Public Library
ATTN: Docs & Genealogy Dept

Elko County Library
ATTN: Librn

Elmire College
ATTN: Librn

Elon College Library
ATTN: Librn

Enoch Pratt Free Library
ATTN: Docs Ofc

Enory University
ATTN: Librn

Evansville & Vanderburgh Cty Public Library
ATTN: Librn

Everett Public Library
ATTN: Librn

Fairleigh Dickinson University
ATTN: Depository Dept

Florida A & M University
ATTN: Librn

Florida Atlantic University Library
ATTN: Div of Pub Docs

OTHER (Continued)

Florida Institute of Technology
ATTN: Library

Florida International University Library
ATTN: Docs Sec

Florida State Library
ATTN: Docs Sec

Florida State University
ATTN: Librn

University of Florida
ATTN: Dir of Library (Reg)
ATTN: Docs Dept

Fond Du Lac Public Library
ATTN: Librn

Ft Hays State University
Ft Hays Kansas State College
ATTN: Librn

Ft Worth Public Library
ATTN: Librn

Free Public Library of Elizabeth
ATTN: Librn

Free Public Library
ATTN: Librn

Freeport Public Library
ATTN: Librn

Fresno Cty Free Library
ATTN: Librn

Gadsden Public Library
ATTN: Librn

Garden Public Library
ATTN: Librn

Gardner Webb College
ATTN: Docs Library

Gary Public Library
ATTN: Librn

Geauga Cty Public Library
ATTN: Librn

Georgetown University Library
ATTN: Gov Docs Room

Georgia Institute of Technology
ATTN: Librn

Georgia Southern College
ATTN: Librn

Georgia Southwestern College
ATTN: Dir of Libraries

Georgia State University Library
ATTN: Librn

OTHER (Continued)

University of Georgia
ATTN: Dir of Libraries (Reg)

Glassboro State College
ATTN: Librn

Gleeson Library
ATTN: Librn

Graceland College
ATTN: Librn

Grand Forks Public City-County Library
ATTN: Librn

Grand Rapids Public Library
ATTN: Dir of Lib

Greenville County Library
ATTN: Librn

Grinnell College Library
ATTN: Librn

Guam RFK Memorial University Library
ATTN: Fed Depository Coll

University of Guam
ATTN: Librn

Gustavus Adolphus College
ATTN: Librn

South Dakota University
ATTN: Librn

Hardin-Simmons University Library
ATTN: Librn

Hartford Public Library
ATTN: Librn

Harvard College Library
ATTN: Dir of Lib

Harvard College Library
ATTN: Serials Rec Div

University of Hawaii Library
ATTN: Gov Docs Coll

Hawaii State Library
ATTN: Fed Docs Unit

University of Hawaii at Monoa
ATTN: Dif of Libraries (Reg)

University of Hawaii
Hilo Campus Library
ATTN: Librn

Haydon Burns Library
ATTN: Librn

Hennepin County Library
ATTN: Gov Docs

Henry Ford Community College Library
ATTN: Librn

OTHER (Continued)

Herbert H. Lehman College
ATTN: Lib Docs Div

Hofstra University Library
ATTN: Docs Dept

Hollins College
ATTN: Librn

Hopkinsville Community College
ATTN: Librn

Wagner College
ATTN: Librn

University of Houston Library
ATTN: Docs Div

Houston Public Library
ATTN: Librn

Tulane University
ATTN: Docs Dept

Hoyt Public Library
ATTN: Librn

Humboldt State College Library
ATTN: Docs Dept

Huntington Park Library
ATTN: Librn

Hutchinson Public Library
ATTN: Librn

Idaho Public Library & Information Center
ATTN: Librn

Idaho State Library
ATTN: Librn

Idaho State University Library
ATTN: Docs Dept

University of Idaho
ATTN: Dir of Libraries (Reg)
ATTN: Docs Sec

University of Illinois Library
ATTN: Docs Sec

Illinois State Library (Reg)
ATTN: Gov Docs Br

Illinois University at Urbana-Champaign
ATTN: P. Watson Docs Lib

Illinois Valley Community College
ATTN: Library

Illinois State University
ATTN: Librn

Indiana State Library (Reg)
ATTN: Serial Sec

Indiana State University
ATTN: Docs Library

OTHER (Continued)

Indiana University Library
ATTN: Docs Dept

Indianapolis Marion County Public Library
ATTN: Social Science Div

Iowa State University Library
ATTN: Gov Docs Dept

Iowa University Library
ATTN: Gov Docs Dept

Butler University
ATTN: Librn

Isaac Delchdo College
ATTN: Librn

James Madison University
ATTN: Librn

Jefferson County Public Library
Lakewood Regional Library
ATTN: Librn

Jersey City State College
ATTN: F. A. Irwin Library Periodicals
Doc Sec

John Hopkins University
ATTN: Docs Library

La Roche College
ATTN: Librn

Johnson Free Public Library
ATTN: Librn

Kalamazoo Public Library
ATTN: Librn

Kansas City Public Library
ATTN: Docs Div

Kansas State Library
ATTN: Librn

Kansas State University Library
ATTN: Docs Dept

University of Kansas
ATTN: Dir of Library (Reg)

University of Texas
ATTN: Lyndon B. Johnson School of Public
Affairs Library

Maine Maritime Academy
ATTN: Librn

University of Maine
ATTN: Librn

OTHER (Continued)

Kent State University Library
ATTN: Docs Div

Kentucky Dept of Library & Archives
ATTN: Docs Sec

University of Kentucky
ATTN: Gov Pub Dept
ATTN: Dir of Lib (Reg)

Kenyon College Library
ATTN: Librn

Lake Forest College
ATTN: Librn

Lake Sumter Community College Library
ATTN: Librn

Lakeland Public Library
ATTN: Librn

Lancaster Regional Library
ATTN: Librn

Lawrence University
ATTN: Docs Dept

Brigham Young University
ATTN: Docs & Map Sec

Lewis University Library
ATTN: Librn

Library and Statutory Dist & Svc
2 cy ATTN: Librn

Earlham College
ATTN: Librn

Little Rock Public Library
ATTN: Librn

Long Beach Public Library
ATTN: Librn

Los Angeles Public Library
ATTN: Serials Div U.S. Docs

Louisiana State University
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ATTN: Dir of Libraries (Reg)

Louisville Free Public Library
ATTN: Librn

Louisville University Library
ATTN: Librn

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JRB-2-816-03-823-00 DNA001-79-C-0473
DNA-6003F NL

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OTHER (Continued)

Manchester City Library
ATTN: Librn

Mankato State College
ATTN: Gov Pubs

University of Maine at Farmington
ATTN: Dir of Libraries

Marathon County Public Library
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Principia College
ATTN: Librn

University of Maryland
ATTN: McKeldin Library Docs Div

University of Maryland
ATTN: Librn

University of Massachusetts
ATTN: Gov Docs Coll

Maui Public Library
Kahului Branch
ATTN: Librn

McNeese State University
ATTN: Librn

Memphis & Shelby County Public Library &
Information Center
ATTN: Librn

Memphis & Shelby County Public Library &
Information Center
ATTN: Librn

Memphis State University
ATTN: Librn

Mercer University
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Mesa County Public Library
ATTN: Librn

Miami Dade Community College
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University of Miami Library
ATTN: Gov Pubs

Miami Public Library
ATTN: Docs Div

Miami University Library
ATTN: Docs Dept

University of Santa Clara
ATTN: Docs Div

Michigan State Library
ATTN: Librn

Michigan State University Library
ATTN: Librn

OTHER (Continued)

Michigan Tech University
ATTN: Lib Docs Dept

University of Michigan
ATTN: Acq Sec Docs Unit

Middlebury College Library
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Millersville State College
ATTN: Librn

State University of New York
ATTN: Docs Librn

Milwaukee Public Library
ATTN: Librn

Minneapolis Public Library
ATTN: Librn

University of Minnesota
ATTN: Dir of Libraries (Reg)

Minot State College
ATTN: Librn

Mississippi State University
ATTN: Librn

University of Mississippi
ATTN: Dir of Libraries

Missouri University at Kansas City General
ATTN: Librn

University of Missouri Library
ATTN: Gov Docs

M.I.T. Libraries
ATTN: Librn

Mobile Public Library
ATTN: Gov Info Div

Midwestern University
ATTN: Librn

Montana State Library
ATTN: Librn

Montana State University Library
ATTN: Librn

University of Montana
ATTN: Dir of Libraries (Reg)

Montebello Library
ATTN: Librn

Morhead State College
ATTN: Library

Mt Prospect Public Library
ATTN: Gov't Info Ctr

Murray State University Library
ATTN: Lib

OTHER (Continued)

Nassau Library System
ATTN: Librn

Natrona County Public Library
ATTN: Librn

Nebraska Library Community
Nebraska Public Clearinghouse
ATTN: Librn

University of Nebraska at Omaha
ATTN: Univ Lib Docs

Nebraska Western College Library
ATTN: Librn

University of Nebraska
ATTN: Dir of Libraries (Reg)

University of Nebraska Library
ATTN: Acquisitions Dept

University of Nevada Library
ATTN: Gov Pubs Dept

University of Nevada at Las Vegas
ATTN: Dir of Libraries

New Hampshire University Library
ATTN: Librn

New Hanover County Public Library
ATTN: Librn

New Mexico State Library
ATTN: Librn

New Mexico State University
ATTN: Lib Docs Div

University of New Mexico
ATTN: Dir of Libraries (Reg)

University of New Orleans Library
ATTN: Gov Docs Div

New Orleans Public Library
ATTN: Librn

New York Public Library
ATTN: Librn

New York State Library
ATTN: Docs Control Cultural Ed Ctr

State University of New York at Stony Brook
ATTN: Main Lib Docs Sec

State University of New York Col Memorial Lib
at Cortland
ATTN: Librn

State University of New York
ATTN: Lib Docs Sec

North Texas State University Library
ATTN: Librn

OTHER (Continued)

State University of New York
ATTN: Librn

New York State University
ATTN: Docs Ctr

State University of New York
ATTN: Docs Dept

New York University Library
ATTN: Docs Dept

Newark Free Library
ATTN: Librn

Newark Public Library
ATTN: Librn

Niagara Falls Public Library
ATTN: Librn

Nicholls State University Library
ATTN: Docs Div

Nieves M. Flores Memorial Library
ATTN: Librn

Norfolk Public Library
ATTN: R. Parker

North Carolina Agricultural & Tech State
University
ATTN: Librn

University of North Carolina at Charlotte
ATTN: Atkins Lib Doc Dept

University Library of North Carolina at Greensboro
ATTN: Librn

University of North Carolina at Wilmington
ATTN: Librn

North Carolina Central University
ATTN: Librn

North Carolina State University
ATTN: Librn

University of North Carolina at Wilmington
ATTN: Librn

University of North Carolina
ATTN: BA SS Div Docs

North Dakota State University Library
ATTN: Docs Librn

University of North Dakota
ATTN: Librn

University of North Dakota
ATTN: Dir of Libraries

North Georgia College
ATTN: Librn

OTHER (Continued)

Northeast Missouri State Univeristy
ATTN: Librn

Northeastern Oklahoma State University
ATTN: Librn

Northeastern University
ATTN: Dodge Library

Northern Arizona University Library
ATTN: Gov Docs Dept

Northern Illinois University
ATTN: Librn

Northern Michigan University
ATTN: Docs

Northern Montana College Library
ATTN: Librn

Northwestern Michigan College
ATTN: Librn

Northwestern State University
ATTN: Librn

Northwestern State University Library
ATTN: Librn

Northwestern University Library
ATTN: Gov Pubs Dept

Norwalk Public Library
ATTN: Librn

Northeastern Illinois University
ATTN: Library

University of Notre Dame
ATTN: Doc Ctr

Oakland Community College
ATTN: Librn

Oakland Public Library
ATTN: Librn

Oberlin College Library
ATTN: Librn

Ocean County College
ATTN: Librn

Ohio State Library
ATTN: Librn

Ohio State University
ATTN: Lib Docs Div

Ohio University Library
ATTN: Docs Dept

Oklahoma City University Library
ATTN: Librn

Oklahoma City University Library
ATTN: Librn

OTHER (Continued)

Oklahoma Department of Libraries
ATTN: U.S. Gov Docs

University of Oklahoma
ATTN: Docs Div

Old Dominion University
ATTN: Doc Dept Univ Lib

Olivet College Library
ATTN: Librn

Omaha Public Library Clark Branch
ATTN: Librn

Onondaga County Public Library
ATTN: Gov Docs Sec

Oregon State Library
ATTN: Librn

University of Oregon
ATTN: Docs Sec

Ouachita Baptist University
ATTN: Librn

Pan American University Library
ATTN: Librn

Passaic Public Library
ATTN: Librn

Queens College
ATTN: Docs Dept

Pennsylvania State Library
ATTN: Gov Pubs Sec

Pennsylvania State University
ATTN: Lib Doc Sec

University of Pennsylvania
ATTN: Dir of Libraries

University of Denver
ATTN: Penrose Library

Peoria Public Library
ATTN: Business, Science & Tech Dept

Free Library of Philadelphia
ATTN: Gov Pubs Dept

Philipsburg Free Public Library
ATTN: Library

Phoenix Public Library
ATTN: Librn

University of Pittsburgh
ATTN: Docs Office, G8

Plainfield Public Library
ATTN: Librn

OTHER (Continued)

Popular Creek Public Library District
ATTN: Librn

Association of Portland Library
ATTN: Librn

Portland Public Library
ATTN: Librn

Portland State University Library
ATTN: Librn

Pratt Institute Library
ATTN: Librn

Louisiana Tech University
ATTN: Librn

Princeton University Library
ATTN: Docs Div

Providence College
ATTN: Librn

Providence Public Library
ATTN: Librn

Public Library Cincinnati & Hamilton County
ATTN: Librn

Public Library of Nashville and Davidson County
ATTN: Librn

University of Puerto Rico
ATTN: Doc & Maps Room

Purdue University Library
ATTN: Librn

Quinebaug Valley Community College
ATTN: Librn

Auburn University
ATTN: Microforms & Docs Dept

Rapid City Public Library
ATTN: Librn

Reading Public Library
ATTN: Librn

Reed College Library
ATTN: Librn

Augusta College
ATTN: Librn

University of Rhode Island Library
ATTN: Gov Pubs Ofc

University of Rhode Island
ATTN: Dir of Libraries

Rice University
ATTN: Dir of Libraries

Louisiana College
ATTN: Librn

OTHER (Continued)

Richland County Public Library
ATTN: Librn

Riverside Public Library
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Western Washington University
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